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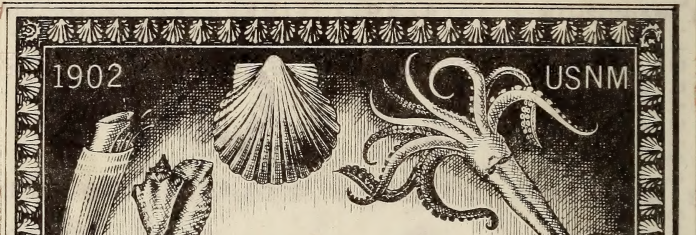

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PROCEEDINGS

Division of Mollusks
Sectional Library

OF THE

Boston Society of Natural History.

VOL. XVI.

1873–1874.

BOSTON:
PRINTED FOR THE SOCIETY.
1874.

PUBLISHING COMMITTEE.

T. T. Bouvé.	Thomas M. Brewer.
Samuel L. Abbot.	A. S. Packard, Jr.

Edw. Burgess.

PRESS OF A. A. KINGMAN.
MUSEUM OF BOSTON SOCIETY OF NATURAL HISTORY,
BERKELEY STREET.

3/10

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PROCEEDINGS

OF THE

BOSTON SOCIETY OF NATURAL HISTORY.

TAKEN FROM THE SOCIETY'S RECORDS.

Annual Meeting. May 7, 1873.

Vice-President Dr. Chas. T. Jackson in the chair. Thirty-five persons present.

Mr. Edward Burgess presented the following report: —

In the absence of the Custodian, the duty of presenting the usual Annual Report on the condition and operations of the Society falls upon me, and I may, I think, congratulate myself in being able to review a year which, on the whole, has been very prosperous.

During the past year, two Honorary Members, one Corresponding and twenty Resident Members have been elected. Eighteen general Meetings of the Society, six of the Section of Microscopy, and six of the Section of Entomology, have been held. The average attendance at the former has been twenty-five, which shows, I am sorry to say, a diminished attendance, partly to be explained, perhaps as the effect of the "great fire", while the great number of lectures and other attractions in the city during the winter has also tended to diminish our numbers. Nevertheless, as from sister Societies reports of similar decrease in the interest of their meetings reach us, we must believe that the causes referred to cannot wholly account for the fact in our own case. There seems to be a feeling growing up among naturalists that Society meetings are unnecessary; they often do not care to hear the results of studies in fields outside of their own specialties, or they prefer to read the papers printed in a Society's publications, rather than to hear what is often an unsatisfactory oral abstract of their contents. But whatever the causes may be, it can hardly be doubted that the meetings, if rendered interesting, would do much to create and foster a taste for the study of Nature among our members, and I earnestly hope that your attention may be given to a subject I believe so important.

Four courses of "Lowell Lectures" have been given during the winter, and a fifth, a course on Comparative Anatomy, by Mr. B. Waterhouse Hawkins, is in progress. The first course, The Principles of Zoology, by Prof. Edw. S. Morse, had an average audience of sixty persons; the second, Mineralogy, by Mr. L. S. Burbank, forty persons; the third, Evenings with the Microscope, by the Rev. E. C. Bolles, two hundred and fifty persons; and the fourth, Chemical and Physical Geology, by Prof. T. Sterry Hunt, one hundred and fifty persons. Mr. Hawkins' lectures have had, thus far, an average attendance of fifty.

The "Teachers' School of Science" has unfortunately been necessarily suspended this winter, but it is to be hoped, will be again in operation next season. The course of instruction in Botany by Dr. Farlow was completed last June, and the number of teachers attending remained undiminished to the end. The value of the school in advancing the study of Natural History can not be overestimated.

We have published since the last Annual Meeting, two numbers of the Memoirs, one on the embryology of *Limulus Polyphemus*, by Dr. A. S. Packard, Jr., and a description of

Balœnoptera musculus, by Dr. T. Dwight Jr. A third number, containing a paper on the fossil Myriapods of Nova Scotia, by Mr. S. H. Scudder, will be issued in a few days.

Of the "Proceedings," two parts, completing the fourteenth volume, have been issued, and the first part of Vol. xv.; the second part will be distributed in a few days. This part contains the printed record of meetings down to January 1, 1873, besides which matter nearly sufficient for a third part, which will include reports of the meeting of last month, is in type. It will therefore be seen that our publications are in a comparatively satisfactory condition.

Six Societies have favored us for the first time with their publications:—

Société Académique de Maine et Loire. . . .	Angers.
Société des Sciences historiques et naturelles de l'Yonne.	Auxerre.
Accademia Gioenia di Scienze Naturali . . .	Catania.
Naturwissenschaftliche Verein für Steiermark.	Gratz.
Société d'Agriculture, Industrie, Sciences et Arts du Départment de la Lozère.	Mende.
Scientific Association of Trinidad.	Trinidad.

Important sets of publications have also been received from the Batarvaasch Genootschap van Kunsten en Wetenschappen, the Naturwissenschaftliche Gesellschaft Isis zu Dresden, the Scientific Association of Trinidad, and, especially, the Société d'Agriculture, Industrie, Sciences et Arts du Département de la Lozère, à Mende.

We have also subscribed to several new scientific journals, among them Max Schultze's Archiv für Mikroskopische Anatomie, of which we have obtained a complete set, and exchange with the "Lens", published by the Illinois State Microscopical Society, of Chicago.

No important change has been made in the Library since the last Report. One hundred and twenty-five volumes have been bound, but a large outlay for this work is still most necessary. Miss Foster has condensed the card catalogue, by the omission of cross references to such general words as "report" "memoir," "monograph," and the like, which will greatly facilitate its use.

The pressing need of adding a gallery to the back library has been referred to in the Annual Reports for several years, and I hope for the last time in vain. Many alcoves are running over with the rapidly multiplying publications of Societies, and until the new gallery allows a rearrangement of the library, nothing can be done for their relief. So, too, it is useless to correct the many false references of the card catalogue, until the rearrangement is effected.

To complete our many incomplete sets of Society publication, or scientific journals, much outlay is needed *at once*, as many of them are out of print, and are becoming more rare and expensive. We lack, also, many recent works in all departments.

The additions to the Library during the year number 1338, which may be classified as follows: —

	8vo.	4to.	Fol.	Total.
Volumes	222	50	5	277
Parts	668	179	5	852
Pamphlets	167	22		189
Maps and Charts				20
Total				1338

During the year 532 books have been taken from the Library by 101 persons.

The chief improvement in the Museum has been the alteration of the cases in the upper galleries for the reception of the extensive collection of birds. Since the last Report the cases on the west side of the main upper gallery, and those around the galleries of the four corner rooms, have been altered. This work is therefore now completed, and the entire bird collection is already placed in the new cases. The railing cases around the lower gallery, containing birds' nests and eggs, have been exchanged with those of the upper, containing the New England collection of insects, thus bringing both these collections into their appropriate places.

New and admirable cases have also been made on the entrance floor for the reception of the valuable Herbarium presented by John Amory Lowell, Esq.

The superintendence of the exchange of the various collections of the two galleries occupied most of Prof. Hyatt's time before his departure for Europe, in August. These changes, suggested and executed by Prof. Hyatt, enable the visitor, by entering the first gallery and passing around to the right, to study, in order, the Zoological collections, beginning with the sponges and passing to the higher groups. In this series, the birds will be represented by a type collection representing the principal modifications of the group, while the grand ornithological collection will be confined to the gallery above, and from its great size can never be of great value as an instructive public collection. That portion of the gallery unoccupied by the general collections, is reserved for the New England Faunal collections, which are quite complete, except in the group of Mammals. This, however, can be readily improved. The New England insects will occupy the railing cases around the gallery, the Coleoptera and Lepidoptera being already displayed and identified as far as possible, and the other groups will be added, I hope, before long.

The position of assistant in the Museum, left vacant by the resignation of Mr. F. G. Sanborn last May, has been filled by Mr. James H. Emerton. Mr. Emerton entered upon his duties in June, and his work will show for itself throughout the remainder of this report.

A beginning at a comprehensive system of labelling the collections has been made. Large labels have already been placed over the zoological collections indicating the class groups, and others will soon be added, showing the families or giving other information. This is an important step towards publishing a visitor's catalogue, and will add greatly to the value of the Museum as a means of instruction. The Crustacea and a few other groups have also been labelled with printed labels, and their neatness and legibility is so striking that it would be well to replace the old labels in a similar way, throughout the Museum.

The duplicates of all the zoological collections have been assorted by Mr. Emerton, and arranged in the basement or elsewhere, so that they are easily available for the many purposes to which they can be applied.

Little has been done during the year in the collection of mammals, except the change of arrangement implied in the alterations of which I have already spoken. A Moose skin has been purchased and is now being stuffed for the N. E. collection.

The principal work done in the bird collections has also been referred to. The transfer of these collections has been a work of much labor. Mr. Allen has given fifty days to their rearrangement, and much of Prof. Hyatt's time was also devoted to the work, and important assistance has been given by Messrs. Emerton and Saltonstall. The collection seems quite free from Anthreni or other pests, and the new cases will easily preserve it in the future.

Much work remains to be done in identifying and labelling. Mr. Robert Ridgway has, during the winter, carefully studied and identified the birds of prey, and similar work is needed in other groups. Dr. Brewer has examined and identified the whole collection of skins, and distributed them in groups so as to be easily accessible. The species in this collection not represented among the mounted birds have been laid aside, and Mr. Arthur Smith has already nicely mounted a large number of them, and will continue the work until completed.

Valuable donations have been received from the Smithsonian Institution, principally a large collection of American waders, and from Messrs. Kumlien, Aiken and Bendire; besides numerous smaller gifts. A number of birds have also been purchased of Mr. Maynard for the New England Faunal Collection.

The reptiles have been arranged by Mr. Emerton, and but little other work has been done. Quite a number of New

England fishes have been stuffed and placed in the cases. For specimens in these classes we are indebted to Mrs. R. C. Greenleaf, Jr., and to Dr. Kneeland, Mr. T. M. Coffin, and others, but especially to the U. S. Fish Commission for a large number of specimens from Eastport.

Mr. Sprague has been engaged during the greater part of the year with the insect collections, and has revised the Harris Coleoptera from the Carabidæ through the Elateridæ, besides arranging and naming the New England species to the same extent. Mr. Sprague has also examined and safely secured our collections of the other orders of insects. Dr. Hagen has kindly studied and identified the Harris Neuroptera and pseudo-Neuroptera, and prepared an exhaustive report on these groups, which is in type for the Proceedings. Mr. Emerton is engaged in the arrangement of the spiders, when his other duties permit, and has greatly increased their number from his own extensive collections. Mr. Emerton has also arranged the biological collection in one of the wall-cases on the western end of the gallery.

We are indebted to Mr. Sanborn for very large donations of insects of all orders, also to Mr. Ernest Papendiek for a fine collection of European Coleoptera carefully identified, and containing many rare forms, and to many others for smaller gifts.

Dr. P. P. Carpenter is still engaged in the study of our Mollusca in Montreal. During the year he has devoted 592 hours to this work, which has been done slowly and thoroughly. The shells have been carefully compared with the Cuming collection, and the original authorities have been consulted. Since the beginning of the work Dr. Carpenter has arranged more than 1900 species, and has selected and mounted for the permanent collection 10,500 specimens. The remaining specimens have been named and distributed into about 90 series of various sizes, suitable for exchange or for colleges, schools, etc. The principal set has been prepared for the Chicago Academy of Sciences. Dr. Carpenter has chiefly been occupied with the larger and more showy genera, and has completed the Proboscidefera, the Toxifera and a few families of the Rostrifers and Opisthobranchiates.

As for the remaining invertebrates Mr. Emerton has labelled over 2000 bottles of Crustacea, and also many New England worms and radiates. He has mounted on plaster of Paris or wooden stands many corals and sponges, and prepared new labels for the former.

Collections of marine invertebrates were made at Eastport last summer by Messrs. Emerton and Saltonstall, and presented to the Society.

No change has been made during the year in the collection of the Microscopical department. I would suggest that as soon as possible a suitable person be employed to arrange this large collection, and put it in available order for students.

The increasing duties of the members of the committee on Comparative Anatomy have not allowed them to devote so much time to their collection as in the last two years. The "homological series," however, has been nearly completed, and several dissections and wet preparations have been added. The series of hearts is now in good condition.

During the winter new locks have been put on the cases in the two corner rooms, and the same should be done with the cases around the main hall, as the present fastenings are very inconvenient. It would be well, also, to introduce glass partitions at suitable points in the cases, as a prevention against dust.

Much work has been done during the year on the collection of fossils, which is now arranged in the best possible manner, for exhibition and study. Few additions have been made to the collection, a most valuable one, however, is a trunk of a Sigillaria from the Joggins Mine, Nova Scotia, presented by the Institute of Technology. The trunk is about six feet in height, and will make a striking object in our entrance hall. A number of specimens have also been received from Mr. Ernest Papendiek.

In the Botanical Department the chief work has been the transfer of the Lowell Herbarium to the new cases already mentioned. The other specimens have also been examined and dusted during the year, but the present cases are so poorly made that such an examination should be made every two or three months to preserve the collection. The Committee reports the collection to be now as large, or perhaps larger, than it should be, and, until a catalogue is published it can be of little use to any one.

Few additions have been made during the year, the most important being some fruits from the Sandwich Islands preserved in alcohol, collected and presented by Dr. Kneeland.

The collections of minerals is now in good condition, a very large and valuable addition, the collection of Rev. Mr. Beadle, of Philadelphia, has been made by purchase, a portion of the cost being subscribed by two members of the Society, and a part of the remainder obtained by the sale of duplicates. The specimens thus obtained, include many of large size and exceeding beauty, and when they can be placed on exhibition will greatly add to the interest of the collction. New cases will have to be constructed, however for its proper arrangement.

Mr. Thos. Gaffield has presented a beautiful Japanese crystal globe to the collection.

The number of visitors to the Museum seems steadily to increase, quite a number of schools have also visited the collection with their teachers during the year. The Museum was open daily to the public during the Peace Jubilee, when the city provided two special police for its protection. During the summer, owing to the neglect of the city government to send police officers on visitor's days, considerable injury was done by visitors to the building and collections, it was therefore decided in October to close the doors until a permanent arrangement for protection could be made. The building was therefore closed for two weeks, during which time, owing to the exertion of the President and others, we were promised two policemen regularly on public days. The promise was however but ill kept, and often only one officer appeared, and he perhaps quite late, and the Museum was even necessarily closed several times during the winter. In March however, exertions were made to obtain police protection which could be depended on, and since that time no difficulty has been experienced, two men being always in attendance.

Mr. Edward Pickering presented the following report of the Treasurer for the past year:—

Report of E. Pickering, Treasurer, on the Financial Affairs of the Society, for the year ending April 30th, 1873.

Receipts.			
Dividends and Interest			$9,422.98
Courtis Fund Income			666.98
Pratt Fund Income.			872.00
H. F. Wolcott Fund Income			464.00
Walker Fund Income, one half			1,233.15
Entomological Fund Income			40.00
Bulfinch Street Estate Fund Income			1,632.00
Admission Fees			130.00
Annual Assessments			1,215.00
Lowell Institute Subsidy for Lectures			1,157.73
Miscellaneous Receipts			370.31
J. Cumming's Donation			298.39
			$17,508.54
Accumulation of Walker Prize Fund			1,024.06
			$18,532.60
Expenditures.			
Museum and Furniture		$1,166.49	
Cabinet		2,042.87	
Library		940.88	
Memoirs and Publications	$1,153.86		
Less receipts	809.82		
		344.04	
Gas		152.21	
Fuel		503.05	
Repairs of Museum		1,551.05	
Lectures		1,157.73	
Salaries		5,775.18	
Insurance		2.346.00	
General Expenses		1,260.12	
			$17,189.62
Balance			1,342.98
			$18,532.60

The following is a statement of the Property of the Society, exclusive of the Cabinet and Library.

Museum.		
Museum and Furniture per last Report	$138,989.94	
Expended during the year	1,166.49	$140,156.43
Walker Fund.		
Notes secured by mortgage		41,105.00
Walker Prize Fund.		
18 Shares National Webster Bank	$1,966.00	
29 " Philadelphia, Wilmington & Balt. R.R. Co.	1,532.92	
10 " Ogd. & Lake Champlain R.R. Co. Preferred.	1,077.00	
Cash	812.95	5,388.87
Bulfinch St. Estate Fund.		
126 Shares Chicago, Burl. & Quincy R. R. Co.	$15,980.75	
84 " Tremont National Bank.	10,122.00	
2 " Globe " "	257.12	
12 " Ogdensburg & Lake Champlain R.R. Co. Preferred	1,281.50	
19 " Phila., Wilmington & Balt. R.R. Co.	1.038.75	28,680.12
Courtis Fund.		
50 Shares Globe National Bank	$6,250 00	
35 Shares Philadelphia, Wilmington & Balt. R.R. Co.	1,827.50	
$400 U. S. 5-20 Bonds	425.00	8,502.50
S. P. Pratt Fund.		
58 Shares Philadelphia, Wilmington & Balt. R.R. Co.	$3,057.25	
50 " Norwich & Worcester R.R. Co.	5,212.75	
10 " National Webster Bank	1,072.75	
6 " Boston National "	657.25	10,000.00
H. F. Wolcott Fund.		
60 Shares Philadelphia, Wilmington & Balt. R.R. Co.	$3,277.70	
28 " Ogd. & Lake Champlain R.R. Co. Preferred.	3,031.25	6,308.95
Entomological Fund.		
5 Shares National Webster Bank		550.00
General Fund.		
17 Shares Bates Manufacturing Co.	$1,700.00	
35 " Everett Mills	3,500.00	
30 " Hamilton Woolen Mills	7,500.00	
80 " Washington Mills	8,000.00	
13 " Cocheco Manuf. Co.	7,800.00	
2 " Lowell Manuf. Co.	1,800.00	
8 " Laconia Manuf. Co.	3,228.69	
4 " Pepperell Manuf. Co.	2,350.25	
1 " Amoskeag Manuf. Co.	1,400.00	
3 " Essex County Manuf. Co.	405.00	
2 " Manchester Print Works	1,550.00	
1 " New England Glass Co.	620.00	
2 " Merrimack Manuf. Co.	2,220.00	
141 " Vermont and Canada R.R. Co., Pref. St'k.	8,460,00	
98 " Michigan Central R.R. Co.	11,287.00	
50 " Ogdensb'g & Lake Champl'n R.R. Pref. Stk.	5,162.75	
50 " Philadelphia, Wilmington & Balt. R.R. Co.	2,732.60	
2 4-5 " Boston & Lowell R.R. Co.,	1,754.25	
50 " Norwich & Worcester R.R. Co.	5,150.00	
12 " United States Hotel Co.	1,200.00	
20 " National Bank of Redemption	2.465.25	
26 " Tremont National Bank	3,155.01	
50 " Atlas " "	6,046.75	
6 " Globe " "	771.38	
10 " National Webster "	1,134.00	91,392.93
Carried forward		**$332,084.80**

Brought forward		$332,084.80
Cash on hand and Assets	$1,566.53	
Amount of Indebtedness	1,047.70	518.83
Total Value of Property exclusive of Cabinet and Library		$332,603.63

The Fire of November, 1872, subjected the Society to the loss of $2,346.00, in consequence of assessments, and for premiums of insurance; and the following stocks received under the will of our benefactor, W. J. Walker, have become valueless in consequence of the same event.

11 Shares	Neptune Ins. Co.	$3,160.00
18 "	Boston " "	2,160.00
"	Washington Ins. Co.	960.00
	Total	$6,280.00

All which is respectfully submitted,
E. Pickering, Treasurer,
Boston Society of Natural History.

Boston, May 5, 1873.

The report of the Nominating Committee, presented at the last meeting, was again read, and a ballot ordered.

Messrs. Mann and Minot were appointed to collect the votes, and they reported that twenty-seven had been cast, all for the nominees of the committee. The following gentlemen were therefore elected officers for 1873–4.

PRESIDENT,
THOMAS T. BOUVÉ.

VICE-PRESIDENTS,
CHARLES T. JACKSON, M.D., R. C. GREENLEAF.

CORRESPONDING SECRETARY,
SAMUEL L. ABBOT, M.D.

RECORDING SECRETARY,
EDWARD BURGESS.

TREASURER,
EDWARD PICKERING.

LIBRARIAN,
EDWARD BURGESS.

CUSTODIAN,
ALPHEUS HYATT.

COMMITTEES ON DEPARTMENTS.

Minerals.

Thomas T. Bouvé,
Charles T. Jackson, M.D.,
L. S. Burbank.

Palæontology.

Thos. T. Bouvé,
N. S. Shaler,
W. H. Niles.

Microscopy.

Edwin Bicknell,
R. C. Greenleaf,
B. Joy Jeffries, M.D.

Radiates, Crustaceans and Worms.

A. S. Packard, Jr., M.D.,
A. E. Verrill,
Alex. E. Agassiz.

Insects.

S. H. Scudder,
Edward Burgess,
A. S. Packard, Jr., M.D.

Birds.

Thomas M. Brewer, M.D.,
Samuel Cabot, M.D.,
J. A. Allen.

Geology.

Wm. H. Niles,
John Cummings.

Botany.

Wm. T. Brigham,
Charles J. Sprague,
J. Amory Lowell.

Comparative Anatomy.

Thomas Dwight, Jr., M.D.,
Jeffries Wyman, M.D.,
J. C. White, M.D.

Mollusks.

Edward S. Morse,
J. Henry Blake,
Levi L. Thaxter.

Fishes and Reptiles.

F. W. Putnam,
S. Kneeland, M.D.,
Richard Bliss, Jr.

Mammals.

J. A. Allen,
J. H. Emerton,
J. B. S. Jackson, M.D.

The following paper was presented:

Catalogue of the Phalænidæ of California. No. 2.

By A. S. Packard, Jr., M.D.

The receipt of a valuable collection from Mr. Henry Edwards of San Francisco leads me to publish a number of new species contained in the collection, in addition to those described in these Proceedings, Vol. xiii, p. 381. A large proportion of the species received from Mr. Edwards are unique specimens from his collection, and I am much indebted to the liberal spirit he has shown in entrusting them to me for study.

Thanks to his exertions, and the labors of Mr. J. Behrens of the same city, and Mr. Junius Holleman of Goose Lake, Siskiyou Co., Cal., and a collection made by Mr. A. Agassiz for the Museum of Comparative Zoology, as well as the account of Californian species given by M. Guenée, in his work on the "Phalènites," we are able to enumerate about 90 species from California, Nevada and Oregon. Though this is probably less than one-third of the number that will be found to inhabit California and the States adjacent, yet I think we have sufficient data to enable us to make a preliminary comparison, our conclusions being strengthened by what we know of other

Lepidopterous families inhabiting the Pacific States (Oregon, Nevada and California, in distinction from the Atlantic States lying eastward of, and including, the Mississippi basin). I shall reserve for a final monograph of the family, now well advanced, a more complete discussion of the geographical distribution of our Lepidoptera, and it is hoped that much new material may be accumulated, either to disprove or confirm the suggestions here thrown out, and which I wish to be simply regarded as provisional and tentative. I am also hampered in treating of the Californian Phalænid fauna by our scanty knowledge of the species of the Atlantic States, as the number of species which I have been able to accumulate is very small compared with those known to inhabit Europe.

The Phalænidæ (Geometrids) of California (including Oregon and Nevada) seem to be composed of four elements:

1. Of species of genera exclusively American (North and South). Such are *Chœrodes*, *Sicya*, *Hesperumia*, *Tetracis*, *Azelina*, *Gorytodes* and *Metanema*. Certain species of these, with several of *Tephrosia* (a genus largely found in the New World) are the most characteristic of the Pacific slope of the United States.

2. The species next most characteristic belong to the following genera: — *Halia*, *Tephrina*, *Selidosema* and *Heterolocha*. Species of these groups occur in Europe, but especially (all except *Halia* which has a species, *H. wavaria*, living in northern Europe) in southern Europe, around the Mediterranean Sea, Western Asia, and Asia Minor; while species of *Heterolocha* occur in Abyssinia and South America (Quito).

3. The next group comprises a few arctic or circumpolar species of *Coremia*, *Cidaria* and *Larentia*, or of cosmopolite genera, such as *Hypsipetes*, *Cidaria*, *Coremia*, *Eupithecia*, *Scotosia*, *Acidalia* and *Boarmia*.

4. There are four species common to both the Pacific and Atlantic States, viz., *Larentia cumatilis*, *Camptogramma gemmata*, *Tephrosia Canadaria* and *Azelina Hübneraria*.

In the brief introductory remarks to the first part of this Catalogue (these Proceedings, Vol. XIII, 381) we briefly alluded to the fact that some Californian Lepidoptera repeat certain features peculiar to the fauna of Europe. I find that there are but two forms strikingly European among the Phalænidæ, viz., *Numeria Californiaria* Pack. (wrongly described by me as *Ellopia Californiaria*, XIII, p. 384), which is very near the European *Numeria pulveraria*, and quite different from the Atlantic States *N. obfirmaria*, and the genus *Chesias*, which does not, so far as yet known, occur in the Atlantic region.[1]

But if we find a very few species which recall the European fauna, there are, on the other hand, many peculiar European genera which do not occur in the Pacific region. In other groups of Lepidoptera there are some species that recall European types; such, especially, are *Papilio Zolicaon* Boisd., representing the European *P. Machaon*, and the genus *Parnassius*, which does not occur in the Atlantic region.

Going out of the Phalænidæ, we find a few European types of Bombycidæ which occur in California, and are not found in the Atlantic States, such as the genera *Epicallia* and *Callarctia*.

On the other hand, we find in California no such development of the genus *Lithosia* as in Europe, no species of *Zygæna*, no *Psychidæ* (except *Phryganidia*, an aberrant form); no such development of *Hepialus*, while *Xyleutes robiniæ*, as in the Atlantic States, represents the European *Cossus ligniperda*; moreover the various forms of *Lasiocampa*, and other allied genera, are far less numerous, if not quite wanting in the Pacific region.[2]

We miss again in the Pacific States any species of *Telea* or *Tropæa*, forms linking the Atlantic or northeastern American entomological fauna with that of northeastern Asia (*Telea* being represented by the closely allied *Anthærea*, and *Tropæa Luna* being represented by *T. Selene* Leach). California has evidently not borrowed her insect fauna from northern China or Japan.[3]

In the Neuroptera we have strong European features, the genus *Rhaphidia*[4] occurring in the Pacific States, and not in the Atlantic, while *Boreus Californicus* is more like the European *B. hyemalis* than our two Atlantic species.

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[1] I also referred to a supposed species of *Rumia*. On further examination I find that this and the Maine species are types of a genus different from, though allied to, *Rumia*, and accordingly in the present paper call it *Hesperumia*.

[2] *L. carpinifolia* Boisd. is, according to Grote, a species of Gastropacha.

[3] Dr. Boisduval, who was the first to publish a lepidopterous fauna of California, enumerates the following species of Lepidoptera as being common to California and Europe: *Vanessa Atalanta, V. cardui, V. Antiopa, Chelonia caja* and *C. Dahurica, Arctia* (Phragmatobia) *fuliginosa, Gonoptera libatrix, Phlogophora metriculosa, Amphipyra pyramidea, Agrotis exclamationis, A. annexa, A. saucia, A. fumosa, A. ravida, Cucullia asteris, C. lucipara, Plastenis subtusa, Noctua triangulum. N. plecta, Hadena pisi, H. protea, Monogona Hormos, Plusia festucæ, P. questionis, P. ni.*

These are scarcely more distinctive of Europe than of America, some of them being common to the subarctic regions of the two continents, and others may yet prove to be distinct from the European species.

[1] *Rhaphidia* has as yet only been found in Europe, northern Asia, and western North America (MacLachlan).

The crustacean fauna of northeastern America, with Limulus as its most remarkable feature, repeats that of eastern Asia; but on the other hand Dr. Hagen states that the European genus Astacus occurs in California, while Cambarus is only found east of the Rocky Mountains.

Mr. F. W. Putnam informs me that of one hundred and seventy-three genera of fishes given by Günther as inhabiting the seas about Japan, only about thirty-six are represented on the northwestern coast of America, and of these thirty-six the majority are also found in the Atlantic, while about eighty others of the Japanese genera are also represented on the southeastern coast of North America and in the West Indian seas, of which a number are found on the western coast of Central America as well. He also tells me that the fresh water fishes of northern Asia, when compared with those of other regions, more nearly resemble those of the northeastern parts of North America, though a number of the genera are also common to both North America and Europe. By the same authority I am informed that there is a striking resemblance between the reptiles and batrachians of northeastern Asia and northeastern America.

My attention has been drawn to a consideration of these features in the geographical distribution of animals by a perusal of the able and suggestive essay by Prof. Gray on the distribution of Californian plants, in his address at the Dubuque meeting (Aug., 1872) of the American Association for the Advancement of Science, and of Mr. Lesquereux' able papers in Hayden's Geological Reports on the Territories, 1872. The main features in the geographical distribution of land animals are apparently the same with those of plants. Prof. Gray shows that "almost every characteristic form in the vegetation of the Atlantic States is wanting in California, and the characteristic plants and trees of California are wanting here" (*i.e.*, in the Atlantic States). We may, on the whole, say of the Californian Lepidoptera, at least, as Dr. Gray remarks of the plants, that they are "as different from [those] of the eastern Asiatic region (Japan, China and Mandchuria) as they are from those of Atlantic North America. Their near relatives, when they have any in other lands, are mostly southward, on the Mexican plateau. . . . The same may be said of the [insects] of the intervening great plains, except that northward and in the subsaline [insects[1]] there are some close alliances with the [insects] of the steppes of Siberia. And along the crests of high mountain ranges the arctic-alpine [insect-fauna] has sent southward more or less numerous representatives through the whole length of the country" (p. 10). He then refers to the "astonishing similarity" of the flora of the Atlantic United States with that of northeastern Asia. Our actual knowledge of the insect species of northeastern Asia is most vague compared with the exact knowledge of the botanist, and the comparison we have drawn relates only to generic types.

It is evident that the notion of continental bridges in quaternary times, connecting, for example, Asia and California, is quite unnecessary, since there are, so far as is yet known, no forms characteristic of Asia in the Californian fauna, and the grand difficulty is to account for the presence of a certain resemblance to the European fauna in that of California. Here I think Dr. Gray has been the first to indicate a solution of the problem. Our knowledge of American fossil tertiary insects is at present almost *nil*; we must, then, in the absence of any evidence to the contrary, follow the conclusions of Gray with the later confirmation of Lesquereux.

The ancestors of the Californian *Parnassius*, *Rhaphidia*, and other European forms, may have inhabited the Arctic tertiary continent, of which Greenland and Spitzbergen are the remains, and their descendants forced southward have probably lost their foothold in the Atlantic region, and survived in California and Europe, like the Sequoia in California. Something more than similarity of climate is needed to account for the similarity of generic forms; hence community of origin, with high antiquity and a southward migration of forms not of tropical origin, are the factors needed to work out the problem. That something of this sort has taken place in marine animals we know to be the fact. Certain forms now supposed to be extinct on the coast of New England and Scandinavia, such as *Yoldia arctica* Gray (*Nucula Portlandica* Hitchcock), are still living in the seas of Greenland and Spitzbergen. The quaternary fauna of Maine indicates a much more purely arctic assemblage than is at present to be found. This is also the case with the Scandinavian quaternary fauna, according to the researches of Prof. M. Sars. As we have before shown, the circumpolar marine fauna runs down along the coast of northeastern America and of Europe, and the forms common to the two shores have not come one from the other. Europe has not perhaps borrowed in quaternary times from America, but both have been peopled from a purely circumpolar fauna. If there has been any borrowing it has been on the part of Europe, since the fossil musk ox of France and Central Europe is said to be identical with the musk ox of Arctic America. So also on the coast of northeastern Asia and Alaska are circumpolar forms, which have evidently followed the flow of the arctic currents down each coast. The forms which are identical or representative on these two coasts are species derived from the circumpolar fauna; so the forms which are so strikingly similar in northern Japan to those on the coast of New England are, if we mistake not, also derived from the northward. I believe it to be a matter of fact that the Atlantic States species of insects which are common to the two countries, are, if not of circumpolar, at least of subarctical or boreal origin. From these facts we are led to accept the conclusions of Gray and Lesquereux, that co-specific or congeneric forms occurring in California and Europe and Asia, are the remnants of a southward migration from polar tertiary lands during tertiary, and even perhaps cretaceous times; and in proportion to the high antiquity of the migrations there have been changes and extinctions causing the present anomalies in the distribution of organized beings which are now so difficult to account for on any other hypothesis.

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[1] Dr. Leconte has noticed the similarity of our saline-plains beetles, containing so many species of Tenebrionidæ, to the fauna of the deserts and steppes of Asia. (Proc. Amer. Assoc. Adv. Sci., 1851. Albany meeting, 252.) He also states that "the only manner in which the insect fauna of California approaches that of Europe, is in the great abundance of apterous Tenebrionidæ. But in this respect it does not differ from a large part of South America; and by the very form of these Tenebrionidæ, which bear no resemblance at all to those of Europe, the greater relation of the Californian fauna to that of the rest of America, is clearly proved." Mr. Andrew Murray (On the Geographical Relations of the chief Coleopterous Faunæ, p. 36, 1871) also refers to this fact; the genus *Elodes* in California replacing the genus *Blaps*. He adds · "other Heteromerous forms, reminding us of Mediterranean and Asiatic species, occur in California, and the whole of the northwest of America has a greater preponderance of the microtypal stirps than perhaps occurs east of the Rocky Mountains." I should add that Mr. Murray, in explaining the term *microtypal*, states that "the fauna and flora of our own land [Great Britain] may be taken as its type and standard."

For this reason it is not improbable that those species of insects which are more or less cosmopolite (and independently so of human agency) are the most ancient, just as some forms taxonomically the most remote are remnants of earlier geological periods. For example, the curious anomalies in the geographical distribution of *Limulus*, the genus only occurring on the eastern coasts of Asia and North America, accord with its isolation from other Crustacea. Geological extinction has gone hand in hand with geographical isolation. It was a common form in Europe in the jurassic period, and in the next lower (permian) period but one (the triassic intervening), we find other Merostomata and a few Trilobites.

We make these speculations, hoping that much light will be thrown upon the subject by studies on the rich tertiary insect beds of the west, and of the fossil insects in the arctic tertiary and cretaceous formations. Until then we must regard all foundations for these hypotheses as laid by the fossil botanist.

Camptogramma fluviata (Hübn.).

Two females, *i. e.*, *C. gemmata* (Hübn.), now shown to be the female of *C. fluviata* by a writer in the "Entomologists' Intelligencer," 1858, as quoted in Newman's "Illustrated Natural History of British Moths," p. 172.

California (Edwards).

Larentia 12-lineata n. sp. 3 ♂, 5♀.

An unusually small species, half the size of *L. dilutata*, and about as large as *L. albulata* of Europe. ♂ Antennæ well ciliated. Head above whitish gray, in front dark brown; palpi brown at tip, paler below. Body and wings white, with a slight grayish tinge on costa of fore wings and on thorax. Wings of the same form as in *C. dilutata*, except that the apex of the fore wings is rather more pointed. Fore wings white, crossed by about twelve black thread-like lines, waved or scalloped, the outer ones mostly represented by venular black dots. The inner lines are usually scalloped. All the lines are more distinct and broader on the costa, and angulated outwards more or less acutely just below the costa. Across the middle of the wings run three parallel lines finer and nearer together than the others. The marginal row of intervenular black spots distinct on both wings. Hind wings white, with four or five dark slightly marked lines, of which the two inner are scalloped, while the three outer are represented by venular dark points.

Beneath a little more dusky than above, with the lines on the inner half of fore wings wanting; a median double dusky line, ending in a dark clear spot on the costa and inner edge. The lines beyond faint. The marginal black line distinct on both wings. Hind wings marked like fore wings. Discal dots indistinct on both pairs of wings. Abdomen dull whitish unspotted. Fore legs brown, banded with narrow white rings; hind legs whitish.

Length of body ♂, .33, ♀, .30 inch; fore wing ♂, .45, ♀, .40 inch.

This diminutive species seems to occur commonly in California, where it has been collected by Mr. Edwards. It also occurs at San Mateo, Cal., specimens having been collected by Mr. Alex. Agassiz (Mus. Comp. Zoology). It may be recognized by its small size and white, many lineated wings. From Guenée's *L. implicata* it differs in the wings being entirely white and also in the markings as well as the smaller size. We have in the Eastern States a species very near to it, which I describe below as *L. perlineata*,[1] introducing the description here for the sake of comparison.

Larentia cumatilis Pack.

Cidaria cumatilis Grote and Rob. Annals Lyceum Nat. Hist., N. Y., VIII (April, 1867).

Cidaria 4-punctata Pack. Proc. B. S. N. H., XIII, 385 (1871).

I can find no differences between two specimens from the Atlantic States (one G. and R's. type from Buffalo, and one from Maine, collected by myself), and twelve examples from California, collected by Mr. Edwards. It seems to be much more common in California than in the east. It is nearly related to, and congeneric with, *Larentia polata* Boisd. from Labrador and Arctic Europe.

Cidaria nubilata Pack. Proc. B. S. N. H., XIII, 400.

One specimen from Springfield, Oregon, collected by Mr. Junius Holleman.

Cidaria glaucata n. sp. 1 ♀.

Of the size and form of *C. nubilata* Pack., but with the palpi much longer, being of unusual length, the second joint projecting out farther than the head is long, while the third joint is longer and larger than usual. Head whitish on vertex and front; palpi ash brown;

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[1] *Larentia perlineata* n. sp. 1 ♂, 1 ♀, closely resembling in size, shape and markings of wings *L. 12-lineata*. The head is whitish gray above, in front dark brown; the palpi brown at tips above. The fore wings are white, crossed by numerous wavy fine lines about twelve in number, It differs chiefly from *L. 12-lineata*, however, in the median line being much broader and more distinct, and with a broad ochreous shade between it and the line beyond. The hind wings are white, with the scalloped lines on the outer half of the wing very distinct, being continuous and a little diffuse. Beneath much as in *L. 12-lineata*, but with four well marked lines in the hind wings, the innermost quite near the base of the wing. Abdomen whitish gray, unspotted. Legs, two anterior pair dusky above, hinder pair white.

Length of body, ♂ .32, ♀ .30; fore wing, ♂ .45, ♀ .42 inch. Albany, N. Y., May 4th. (Lintner.)

This small species is half the size of *L. dilutata*, and differs in having about twelve fine lines on the fore wings, and four or five unbroken lines on the hind wings. The median line on the fore wings being very distinct and with a brownish and ochreous shade beyond.

antennæ minutely ringed with white and brown. Thorax and fore wings pale glaucous green. Fore wings with a brown squarish spot at base of submedian space; wing clear green beyond, just within the middle crossed by a broad compound band directed obliquely outwards towards the middle of the inner edge; the band is made up of two filiform slightly sinuated blackish and red lines, enclosing on each side of the median wavy smoky gray band a broad green band. Beyond is a broad clear space. A much sinuate submarginal smoky band starts from the inner angle, and after a long outward curve ends on the costa (just below which it is dislocated), at a distance from the apex equal to the thickness of the thorax; some black and reddish scales are strewn along the edge of the band. From a squarish thickened portion, as if broken off from the band, reaches out towards the apical black streak, a similar short black stripe; a marginal narrow thread-like black line. Fringe whitish, dark at the ends of bands. Hind wings whitish, with two parallel curved, slightly scalloped dusky lines, situated nearer the outer edge than usual. Both wings beneath pale whitish, concolorous with the upper side of the hind wings, with very faint indications of two outer parallel dusky lines common to both wings. Legs brown, ringed with white.

Length of body .60, fore wing .70 inch. California (Edwards).

This fine species may at once be known by the pale sea green thorax and fore wings, the latter with the obliquely broad band directed outwards, and by the unusually pale hind wings and under surface of both wings, as well as by the very long palpi.

Hypsipetes viridata n. sp. 1 ♀.

In a perfect state of preservation. Closely allied structurally and as regards size to *H. 5-fasciata*, the palpi being long, and extended as far in front of the head as the latter is long; the outer edge, much as in *H. 5-fasciata*, being less oblique than in some other species; the third subcostal interspace is narrower than in *H. 5-fasciata*. Head, thorax and fore wings deep sea green, mixed with dull clear dark smoky ash, and some yellowish green and a few black scales. Palpi with no green scales, but black and pale ash, being darker below than above. Antennæ finely ringed with white and blackish. Fore wings of a sea green ground color, with numerous fine transverse strigæ, crossed by five clear smoky ashen sinuous bands finely edged with black; the basal very short and narrow close to the base of the wing; the second line is narrow, ends farther from the base of the wing on inner than on costal edge, and is angulated outward conspicuously on median vein. The third band is close to, and parallel with, the second, and twice as wide; it is bent outwards on the median and submedian vein. A fourth faint narrow band close to third. The fifth, or submarginal line, is twice as broad as third, and very remote from the latter (which is within the middle of the wing); it is nearly straight on the inner edge, though curved outwards just below the costa, while the outer edge is deeply and subacutely scalloped between the venules much as in *H. 5-fasciata*; the band is half as wide on the inner edge as on the costa. Fringe on both wings with a faint median line. Hind wings smoky, with two transverse parallel dusky lines. Beneath much as in *H. 5-fasciata*, being smoky ash, with two dusky bands on both wings beyond the middle, broadest and darkest on costa, less curved and farther apart, and farther from outer edge than in *H. 5-fasciata*. A faint discal dot, better marked on hind wings. Abdomen and legs nearly concolorous with hind wings.

Length of body .52, fore wing .67 inch. California (J. Behrens).

This handsome species may be readily recognized by the sea green color of the fore wings, and by wanting the apical oblique streak.

Hypsipetes speciosata n. sp. 2 ♂.

This is by far the largest and most showy species of this genus yet known to us. Body pale ash, with a luteous tinge; palpi long, brown. Fore wings pale green, arranged in broad bands alternating with equally broad blackish bands, varying as usual in width. The green band in the middle of the wing is partly, or almost wholly white. Six unusually distinct black bands; the insertion of wing black; the first band beyond very narrow, and bent outwards on the median vein; the second very broad and more regular than those beyond, bent outwards at right angles in the discal space; the whitish line is edged on each side by blackish interrupted lines, the spots varying much in size. The submarginal band also dislocated, and very irregular, bordered internally with whitish; this band is merged towards the apex with the marginal band, consisting of a row of triangular spots. Fringe dark brown. Beneath costa paler than rest of wing, with five large square dark brown conspicuous spots. Hind wings smoky gray, beneath with two broad, submarginal dusky bands.

Length of body (not including palpi) ♂ .54 inch; fore wing ♂ .73 inch. Mendocino City (A. Agassiz, Mus. Comp. Zool.).

This showy species may be identified by the black and green bands on the fore wings, the central band more or less whitish, and by the large square costal spots on the under side. In one specimen the margin of the fore wing is almost wholly black, with a short vein of whitish green spots.

Melanippe Kodiakata n. sp. 1 ♀.

A little smaller than, but closely allied to, *M. concordata* Walk. from New England. Body and wings blackish, body whitish beneath. Fore wings blackish on basal half, with greyish scales, and a zigzag line just before the black discal mark. Just beyond the discal dot a broad whitish band, wider on costal than on inner edge, diffuse externally; on the inside scalloped, and slightly excavated on the median vein, but not so much so as in *M. concordata*. Beyond this band are two obscure pale wavy lines, the outer ending on the costa, close to the apex (these are wanting in *M. concordata*). Edge of wing with a narrower black line; fringe paler than in the other species, checkered with black. Hind wings with a broad white band, obscure on the hind edge, and angulated outwards just below the middle of the wing. Beneath both wings white, with wide black borders, but white at base, with a basal blackish shade; an outer blackish band enclosing the darker large distinct oval discal dot, and below this angulated outwards. Hind wings white, with a broad black border, and a narrow dark line just beyond the distinct black discal dot, which is much smaller than that on primaries. Legs blackish, ringed with white.

Length of body .37, of fore wing .52 inch. Kodiak Is., Alaska (Edwards).

A smaller species than *M. concordata* Walk., from Hudson's Bay and New England; it differs in the white band on the primaries being much straighter on the inner edge, as it is much less excavated, and in having two greyish lines beyond, while the hind wings have a broad white band, where in *M. concordata* they are entirely black.

Cleora umbrosaria n. sp. 1 ♂.

Body and wings ash colored, or pepper and salt; vertex of head pale ash. Fore wings crossed by two scalloped lines, the scallops rounded, not pointed; the basal line straight from the costa to the median vein, thence curved inwards to the inner edge of the wing; outer line begins on the outer quarter of costa, and follows a nearly straight course to outer third of inner edge, there being no great curve above the third median venule, as in *C. pulchraria* Minot and *pellucidaria* Pack., of the Eastern States. Discal dot black. Hind wings in my single specimen without any line; the wing is speckled with dark gray on the outer third. Beneath, the wings are uniform ash colored, the fore wings scarcely darker than hinder pair. No discal spots, or other markings.

Length of body .55, of fore wing, .75 inch. California (Edwards).

This seems to be a larger species than the two eastern ones, and differs in the outer line being nearly straight in its course, the scallops being well rounded, and in having no line on the hind wings, and no markings apparent on the under side of either pair. The fore wings are much produced at the apex, as in *C. pellucidaria* Pack. The antennæ are broadly pectinated, as usual.

Gorytodes uncanaria Guen. 1 ♂.

Body and antennæ (which are broadly pectinated) pale ash, concolorous with the hind wings. Fore wings ash, speckled with brown, with two dark short longitudinal streaks, one on each side of the base of the median vein. The costal half of the middle area of the wing occupied with a large low irregular triangular dark brown area, edged externally with darker; apex ending in a knob, in one specimen produced angularly outwards, and connected with (sometimes separated from) an irregularly oval patch under the third median venule, and which is traversed by a longitudinal mesial white line. A sinuate white marginal line, beginning just before the apex, and ending on the inner angle, and edged within with dark brown. Fringe pale ash checkered with blackish. A black conspicuous discal dot, in rubbed specimens centered with white. Hind wings pale ash, with a faint discal dot, and a dark narrow marginal line. Beneath more or less marbled with dark speckles. Fore wings with two parallel white lines fading away below the costal region, a slight ochreous tint along the costa; a faint discal dot. Hind wings pepper and salt, with two dark, parallel, broad shades, angulated on the discal interspace; the outer line nearly touching the edge of the wing; discal dot larger and more distinct than on fore wings.

Length of body .60, of fore wing .75 inch. California (Edwards).

A fresh specimen received from Mr. Edwards differs from certain others more rubbed (and which better agree with M. Guenée's description) in having the large oval brown spot below the median vein of fore wings distinctly united with the large costal triangular area, and in the more distinct bands on the under side of the wings.

Gorytodes trilinearia n. sp. 2 ♂.

Whitish ochreous. A larger species than *G. uncanaria,* the antennæ with much shorter pectinations, the palpi as long, but slenderer, the wings of the same form, but with the apex of primaries more rounded, the wing being a little less falcate. Fore wings white at base, and traversed by three white zigzag lines, the basal one on the inner fourth of wing, with a large angle on the submedian space, the apex of the angle filled in with a few black scales, as also the outer side of the line (widest here) in the discal space; from the submedian angle is thrown out a narrow white line, running through the middle of an oval ochreous patch. A longitudinal white streak in the discal space, and beyond a large lunate transverse white spot, the two forming a very distinct exclamation mark. Beyond two parallel zigzag white lines, the inner scalloped deeply below the first median venule; the outer is curved at the apex, and with a broad angle on the independent vein. Fringe white, checkered with dark brown. Hind wings white, fringe white. Beneath as above, but the hind wings are crossed by two irregular, rather distinct and broad bands of ochreous with black scales, and the base of the wing is faintly peppered with dark and ochreous scales.

Length of body .66, fore wing .82 inch. Nevada (Edwards). Arizona (Dr. Palmer, from the Museum of the Department of Agriculture at Washington).

An exceedingly elegant moth, at once recognizable by the three white lines and the mark of exclamation in the discal space, and the narrowly pectinated antennæ. The specimen from Arizona is in bad condition, but does not seem to differ from the Nevada example.

Panagra subminiata n. sp. 1 ♀.

Differs from any other species known to me, by the vermillion red on the costa and veins, especially beneath, the upper side of body and wings being uniform ash, tinged faintly with vermillion. Front reddish ash, dull red on orbits; the greyish hairs projecting between the palpi well marked. Palpi stout and bushy, concolorous with the orbits, with a dark spot beneath; vertex grey, like the thorax. Antennæ reddish. Fore wings reddish ash, especially on the costa and veins. A linear pale brown interrupted curved line, ending in a wider costal spot. Discal dot distinct, brown. Outer line forming a broad sinuate shade ending just before the costa. Fringe concolorous with the rest of the wing, with a faint pale line just beyond the middle. Hind wings a little paler than fore wings, speckled with brown scales; fringe a little darker, as in fore wings. Beneath, both wings deeply tinged with vermillion, especially costa of fore pair and entire hind wings, veins vermillion; between them finely marbled with ash and brown scales. Legs tinged with reddish.

Length of body ? (abdomen wanting); of fore wing .63 inch. Goose Lake, Siskiyou Co., Cal. (J. Holleman).

This fine species, communicated by Mr. Holleman, to whom the Museum of the Peabody Academy is indebted for a good many rare specimens from Northern California and Oregon, may at once be known by the reddish ash upper side of the body and the vermillion color of the under side of the wings, by the absence of the usual line on the hind wings, and by the outer line on primaries being diffuse, not sharply defined as usual.

Halia 4-linearia n. sp. 2 ♂.

Closely resembling *H. wavaria*, to which section of the genus it belongs, the wings being less falcate than in the other species, *marcessaria* and *tripunctaria*. The antennæ are more broadly pectinated than in *H. wavaria*, being in this respect intermediate between *H. wavaria* and *tripunctaria*. Pale ash grey. Head, palpi and body being concolorous with the wings. Fore wings marked as in *H. wavaria*, having four distinct costal brown spots, from which as many lines run parallel to each other to the costa; the second one includes the discal dot, but is straighter, not so much angulated as in *H. wavaria*, nor so wide just above the discal dot; the two outer lines become obsolete in the middle of the wing, but are indicated on the hind edge, the third being close to the fourth, while beyond is a small dusky patch. A row of intervenular black marks, fringe concolorous with the rest of the wings. Hind wings with no marking, except the discal dot, which is quite distinct. Beneath pale ash, more uniformly so than in *H. wavaria*, tinged faintly with ochreous, deeper on costa of fore wings. Discal dots present on both wings, and three faint costal patches.

Length of body .48; fore wing .64 inch. Sierra Nevada, Cal. (Edwards).

Closely resembling *H. wavaria*, it differs in the more broadly pectinated antennæ, the less angulated narrower second line on primaries, and the duller ash on under side of wings, which, especially the secondaries, are beautifully marbled in *wavaria*; in these respects it resembles the species of *Macaria*.

Halia tripunctaria n. sp. 1 ♂, 1 ♀.

Antennæ with much longer pectinations than usual, being much longer than in *H. marcessaria*. Palpi as usual. Fore wings with the apex more produced than in *H. marcessaria,* being acutely falcated. Abdomen without the two rows of black dots present in *marcessaria.* Fore wings uniform fawn color, body and hind wings paler. An inner straight brown line, edged externally with yellowish brown; outer line slightly sinuate. Discal dot large oval lanceolate; two conspicuous dark spots midway between the outer line and the edge of the wing, one being subapical in position. Fringe on both wings a little darker than the wings themselves. No markings on hind wings, no discal dot. Beneath, a decided ochreous tinge, no lines, discal dots distinct on both wings; fringe considerably darker than the rest of the wing. ♀ differs from ♂ in the lines being farther apart.

Length of body ♂ .50, ♀ .50 inch; of fore wing ♂ .60, ♀ .66 inch. California (Edwards and Behrens).

This species differs from *marcessaria* Guen. and *cineraria* Pack., in the much more pectinated antennæ and the absence of lines on the under side of the wings, which beneath are clear ochreous, not speckled with dark scales, while the two spots with the discal spot arranged in a triangle, gives it a characteristic appearance.

Macaria Californiaria Pack. Proc. B. S. N. H., XIII., p. 392.

Two ♀, collected by Mr. J. Holleman, differ from those previously described by me in some important respects; the present description therefore applies better to the more normal form of the species. Pale whitish grey. Orbits and palpi tinged with ochreous. Fore wings with four costal spots, from which more or less obsolete lines run in a faint series of dots across the wing, second spot the broadest, the discal dot forming a part of the line, third spot forming with a part of the line proceeding from it, a large irregular S extending to the middle of the wing, the line continuing beyond in an interrupted series of fine dots, and with a supplementary spot at the end of the S. Halfway between the S and the apex is a fourth small costal dot. Hind wings with an obscure discal spot, and a submarginal transverse shade; the wing is faintly mottled with smoky dots. Beneath both wings with fine transverse subochreous spots, the lines appear beneath of a smoky ochreous, the third line being less sigmoid than above, as it is curved outwards to the angle, and then goes obliquely and in a straight course to outer third of inner side. Discal dots distinct, as above. Hind wings with a distinct outer subochreous broad band near the edge of the wing. A row of dark dots along edge of both wings.

Length of body .32, fore wing .55 inch. Goose Lake, Siskiyou Co., Cal., (J. Holleman).

It may be known by the S-like third costal spot, the more yellowish tint of the under side of the wings, and by the presence of an outer shade on hind wings. The sigmoid spot is much like the bent spot in the middle of the wing in *Halia wavaria.*

Acidalia subalbaria n. sp. 1 ♀.

Allied in general form to *A. 5-linearia,* but with the apex of fore wings much blunter, with the hind wings much shorter, and with the outer edge rounded, instead of angulated. Head and antennæ white, front with a broad black band just below the insertion of antennæ. Cream colored, being whitish with a very faint ochreous tinge, whiter and less speckled, with darker scales than *A. 5-linearia.* Primaries crossed by three light brown lines, the basal slightly curved, farther from the base of the wing than usual. The two outer lines much nearer together than usual, the inner one being narrower and less distinct; both are less oblique than usual, and not waved. Discal dot obsolete. Hind wings with a discal dot, and beyond the two parallel outer lines same as on hind wings. Both wings with a narrow black line at base of the whitish fringe. Beneath cream white, discal dots distinct on both wings, those on primaries largest; beyond them a common diffuse dusky line, straight on fore wings. A fine narrow brown line at base of fringe. Legs white, fore femora and tibiæ blackish in front.

Length of body .30, fore wing .47 inch. California (Edwards).

In this species the wings are clearer whitish than usual, especially on the under side, and the two outer lines are nearer together than usual, while the hind wings are shorter, and with the outer edge less convex than usual in those species in which the hind wings are rounded instead of angulated.

Acidalia rubrolinearia n. sp. 1 ♂, 1 ♀.

Closely allied to *A. Californiaria.* Dull reddish ash; the fore wings with four dull brick red wavy lines (three on hind wings). Body and appendages, including legs, a little darker than wings, especially on the under side of body, where there are black scales mixed with the brown ones. Palpi stout and bushy, with unusually long hairs. Antennæ with long dense ciliæ; beneath black, above pale brown. Wings a little darker at base than externally; fore wings with a basal curved reddish brown line; an indistinct brown discal dot; beyond three parallel dull reddish brown wavy lines, the inner twice as broad as the outer. An interrupted fine black line at the edge of the fringe on both wings. Hind wings with three lines, the inner straight, the broadest and darkest wavy, within which the wing is dusky. Fringe on both wings reddish snuff brown.

Beneath, the wings are a little clearer than above, with the two middle lines very distinct, reddish brown, the inner less wavy than the outer, the wing within being dusky, edge of wing with the black line and fringe as above. Legs reddish brown, tarsi paler, though with scattered black scales.

Length of body ♂, .35, ♀, .33 inch; fore wing ♂ .43, ♀ .43 inch. California (Edwards).

This species is deeper brick red than usual, and the scales on the palpi are longer and more spreading than usual, with four brick red lines crossing the fore wings; the middle line on hind wings is much more waved than in *A. Californiaria* Pack.

Hyria occidentaria n. sp. 1 ♂.

Fore wings with much the same shape as in *H. auroraria* of Europe, though the apex is slightly more rounded, while the hind wings have the outer edge more rotund. Antennæ finely ciliated. Body and wings very pale fawn brown, tinged very faintly with vinous, vertex of head pale; front and palpi dark brown. Fore wings clear pale fawn, with the middle occupied with a broad dark hour-glass shaped band, wider on the front edge than on the inner; the inner side quite regularly hollowed out, the outer side produced outwards in the middle, with two acute parallel teeth, and a third below situated farther within the wing; below this the band dilates on the inner edge, while on the costal side it goes nearly straight to the costa; a diffuse faint submarginal shade. On both wings a row of venular marginal black dots. Fringe long, silky, concolorous with the wing. Hind wings with same markings as on fore wings, but with the submarginal shade rather more distinct; the broad band has two larger teeth on the outer edge, and the shade beyond has two zigzag angles parallel with it. Obscure yellowish discal dots on both wings (distinct under a lens). Legs pale, fore femora and tibiæ dark, Beneath smoky, the bands being replaced by diffuse smoky lines.

Length of body .24, fore wing .33 inch. California (Edwards).

This fine species differs from an undescribed Texan species to which it is structurally closely allied, in having rather darker wings, with the submarginal band much darker, and the form of the middle band quite different.

Eunemoria n. gen. ♂.

Allied to *Nemoria*, but the head is much narrower in front, and not so broad on the vertex; in front the sides are nearly parallel. Palpi about as long as in *Nemoria*, but much stouter, slightly ascending, third joint distinct, thick, rounded. Antennæ pectinated nearly to the ends, the branches short, those in the middle of antennæ about twice as long as the joints. Fore wings shaped much as in *Nemoria*, but rather more pointed at th eapex; outer edge straighter, hind wings long, much more rounded, and not angulated, as in *Nemoria.*

The costal space of fore wings is very much narrower than in *Nemoria*. Abdomen shaped much as in *Nemoria*, being acutely pointed at the tip, which just reaches the anal angle of the hind wings. Hind tibiæ swollen, with four stout acute spurs, while there are but two (terminal) in *Nemoria* (male); a long large accessory tuft, as in *Nemoria*. Hind tarsi slender, nearly two-thirds as long as tibiæ, while in *Nemoria* they are half as long as tibiæ and stouter. The single species known is light green, with a single rather broad common line, not wavy and straight on the fore wings, curved on the hind wings.

Eunemoria unitaria Pack. 1 ♂.

Palpi pink; front red; vertex white and antennæ white above; abdomen white; thorax and wings deep pea green, deeper than in most species of *Nemoria*. Extreme costal edge white. A single common white line crosses both wings; on the primaries it is straight and situated just beyond middle of wing; on hind wings it is well curved, and situated just beyond the middle of the wing. Fringe white, on the outer edge pinkish. Two anterior pair of legs reddish.

Length of body .45, fore wing .53 inch. Nevada (Edwards).

The narrow red front, and structure of hind legs, the pinkish edge to fringe, and rather large size, are the distinguishing marks of this species.

Eunemoria tricoloraria Pack. 1 ♂.

Antennæ well pectinated, white above; palpi stout, red, white along the lower edge, wing much as in the eastern species, *E. rubivora* (Riley sp.) Pack. Front duller red than palpi, vertex white, with a few reddish scales at base. Body and wings pea green. Fore wings green, costa white, tinged with red at the base. Two curved, much wrinkled white lines cross each wing, nearer together and more waved than usual. Fringe green. Whitish at insertion, and at the outer edge. Fore and middle tibiæ and tarsi reddish. Beneath fore wings pale, deeper green on the costal half; basal two-thirds of costa deep red. Hind wings whitish green. The outer line on fore wings faintly reappears. Abdomen wanting.

Length of fore wing .40 inch. California (Edwards).

Chlorosea [1] n. gen.

Belonging apparently to the same group as *Nemoria* and *Eunemoria*, and less closely to *Phorodesma.* Head with the vertex not so broad in proportion as in *Nemoria* or *Pseudoterpna*; front moderately broad, less so, however, than in *Nemoria.* Palpi rather long and slender, projecting farther than usual beyond the front (though not nearly so much so as in *Synchlora*), slightly ascending; third joint small, but distinct. Antennæ pectinated almost to the tip; branches about half as long in proportion as in *Nemoria*; in ♀ slender and filiform. Fore wings shaped much as in *Nemoria,* costa curved in the same manner, apex subacute, outer edge curved in much the same way. The costal space is slightly narrower in proportion than in *Nemoria,* and the fifth subcostal or subapical space is small, being one-fourth as long as the wing, while in *Nemoria* it is much larger, being one-third as long as the costa of the wing. Hind wings of much the same shape as in *Phorodesma* and *Pseudoterpna*, not being produced and subangulated, as in *Nemoria*, or so long and fully rounded, as in *Eunemoria*; the apical region is full and rounded, while the outer edge is very straight. The abdomen does not reach the anal angle of the hind wings; its shape is much as in *Nemoria.* Hind legs unusually small, tibiæ very slender and short, shorter than the tarsi, and with but a single terminal pair of spurs in both sexes. No essential difference between the sexes.

Coloration much as in *Nemoria.* The known species are of larger size than usual in the allied genera.

Palpi less ascending than in *Nemoria,* antennæ one-half as widely pectinated, but wider than in *Eunemoria.* The hind legs are much as in *Phorodesma,* but there is but one pair of spurs, and the vertex is not so broad as in that genus, while the antennæ are pectinated nearer the tip.

Chlorosea Nevadaria n. sp. 1 ♂, 2 ♀.

Pale pea green. Head whitish at the insertion of the antennæ (which are white above), but greenish on the hinder edge of vertex; front pale greenish, pink on the orbits; palpi whitish; thorax green;

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[1] Κλωρός, green; σής, moth.

abdomen white. Both wings pale green; fore wings whitish on extreme edge of costa; an oblique, rather broad band, straight in its course, crosses the wing from just beyond the middle of the inner edge to the outer fifth of the costa; it is situated nearer the outer edge in the ♀. No other markings. Hind wings slightly paler than primaries, with no markings. Beneath uniformly pale green, hind wings a little paler than primaries. Legs whitish, two anterior pairs of tibiæ pink.

Length of body ♂, .55, ♀, .45–.50 inch; fore wing ♂, .70, ♀, 60–.68 inch. Nevada (Edwards).

The smaller of the two ♀ has paler hind wings, and an entirely reddish front. The species may be recognized by the large size, the want of any markings on the hind wings, and by the very slender hind legs with the single pair of tibial spurs.

Tephrosia nigroseriata n. sp. 2 ♂.

Differs from any other Californian species by its rust red color, and its two rows of black points. Palpi long and slender; antennæ thickened, ciliated. Head and thorax pale rust red, concolorous with primaries. Fore wings not falcate, apex, however, subacutely pointed; outer edge full, convex; hind wings not so sinuate as usual on outer edge. Fore wings uniformly pale rust red, with obscure scattered dark scales, and a slight dark discal point; two series of black points, inner oblique, but not curved, angulated slightly on costa; outer row of submarginal venular black dots, and a corresponding series on hind wings. A row of fine black dots along the base of the fringe. Hind wings with no apparent discal dot, paler than fore wings, with no specks. Fringe concolorous with the rest of the wing. Beneath of the same tint as above, with the row of black submarginal dots common to both wings; no inner line. Hind wings much more speckled with black than above, and with a conspicuous black dot. A dusky shade in the middle of the fore wings. Abdomen long and slender, passing beyond the inner angle of secondaries.

Length of body .55, fore wing .60 inch. California (Edwards).

The pale rust red tint, and two distant rows of black points, will serve to distinguish this species from any described by Guenée.

Tephrosia falcataria n. sp. 1 ♂.

This species has remarkably falcate wings, the tip of the fore wings being acute, the costa being more bent down at the tip, and the outer edge excavated much deeper than usual; the costal area is wider, hence the four subcostal venules are shorter than usual, but their mode of branching off is the same, being much as in *T. nigroseriata* Pack., to which the species is more closely allied than any other form known to me. Antennæ well pectinated, dark brown, as usual, contrasting with the rest of the body. Head, thorax and fore wings pale reddish fawn color; hind wings and abdomen much paler, much more whitish than in the other species. Fore wings with very uniformly reddish fawn, with no conspicuous bands or rows of spots and remarkably few scattered dark scales, the wings in all the other species known to me being more or less densely dusted. Discal dot small, black; a submarginal row of about six obscure dusky spots, arranged in a straight line parallel to the outer edge. A marginal series of black venular points. Fringe deeper reddish than wing itself. Hind wings almost whitish fawn, unusually clear, with a few faint scattered dark scales; a dark discal dot; fringe reddish, concolorous with that on fore wings; no other markings on the wing. Beneath both wings alike, a little less pale than hind wings behind, but tinged with reddish on the edges, and more specks. Discal dot and marginal row of dots as above. Fringe darker than rest of wings. Hind wings a little more dusted than primaries. Discal dot much larger and more conspicuous than above. Abdomen not spotted.

Length of body .50, fore wing .64 inch. California (Edwards).

Known by its unusually falcate primaries; its clear wings free from the usual bands and scales, and by its reddish hue.

Tephrosia Canadaria Guen.? ♂. I cannot find any difference between one rubbed ♂ specimen of this species, and individuals from New England, but others are needed for a more thorough comparison.

Hemerophila latifasciaria n. sp. 1 ♂.

Of medium size; antennæ broadly pectinated, hind wings rounded, as usual well dentated. Body and wings pale ash; front with a round dark spot; palpi with the third joint black. Hind edge of prothorax, and hinder edge of the basal segments of the abdomen with a black band. Fore wings pale ash, with a broad curved basal blackish band; outer line slightly oblique; straight on the inner edge, curved inwards in the middle of the wing; thence going straight to the costa; this portion of the line is represented by three or four venular dots, the costal one being the largest, while the posterior two-thirds of the line is bordered externally by two diffuse parallel broad lines, the whole making a broad band. Costal edge speckled with dark ash. Outer edge scalloped, with a black point between each scallop. Hind wings concolorous with fore wings; two parallel slightly waved lines; beyond the middle of the wing a very distinct, nearly straight blackish line, with a supplementary brown shade beyond. A submarginal broad shade. A black line follows the scallops. Fringe whitish. Beneath uniformly pale, costa with transverse dark strigæ, the outer band forms a smoky shade beneath, and on hind wings a smoky line. Legs ash, two anterior pairs of tibiæ and tarsi broadly banded with blackish.

Length of body .60, fore wing .73 inch. California (Edwards).

Metanema aurantiacaria n. sp. 1 ♀.

Body ochreous, wings orange-ochreous. Palpi slender, passing slightly beyond the front. Fore wings orange-ochreous, no inner line apparent, outer line oblique, but in its course very straight, not bent on the costa; it is brick red in color, shaded inside towards the middle of the wing with deep ferruginous orange. No markings on the edge of the wing. A single line on hind wings, straight, not reaching the costa, and of the same color as that on the front wings. Beneath, the wings are of the same color as above, but a little clearer yellow and the lines faintly reappear, that on the fore wings being a little curved.

This species belongs to the same section of the genus as *M. cervinaria* Pack., and is a little smaller, with the apex and angles of the wing more acute; behind the angles the wings are entire. There are no discal dots, and the moth is quite different from Guenée's *M. forficaria*, which does not yet seem to occur in American collections.

Length of body .60, of fore wing .77 inch. Nevada (Edwards).

Recognized by the acutely angled wings, the straight ferruginous line, and the deep orange ochre of the wings.

Eurhinosea[1] nov. gen.

Allied to *Caustoloma*. Head of medium size. Front very wide, much as in *Caustoloma*, the surface being convex, and the sides converging slightly in front. On anterior edge a pointed tuft of converging hairs extending between the palpi. ♂ antennæ subsimple, being ciliated, each joint widening anteriorly, the scales on the front edge being raised and spreading out; in ♀ much more filiform, slightly ciliated. Palpi remarkably long, second joint passing beyond the head by a distance about equal to the width of the front, third joint

[1] Εὖ, well, ῥὶς, ῥινὸς, nose.

unusually long and pointed, as long as second joint is wide. Tongue feebler than in *Caustoloma*, but of about the same size as in *Nematocampa*. Wings somewhat resembling those of *Caustoloma*, but not angulated; fore wings with costa more convex than in *Caustoloma*, but just as in *Nematocampa* and *Venilia*; apex obtusely pointed; outer edge full convex, but not angulated; inner edge two-thirds as long as costa. Hind wings much like those of *Caustoloma* in outline; but not hollowed out below the apex, neither are they convex, but the edge is straight between the apex and middle of the wing. The venation differs from that of *Caustoloma*, which it resembles most, in the costal area being wider, and consequently the costal vein and first three subcostal venules shorter and more oblique, and they are nearer together. On the secondaries the second subcostal venule arises much farther than usual from the discal spot, a third of the way from the dot to the end of the vein, while in *Caustoloma* it arises at the dot. The venation of the secondaries is more like *Nematocampa*.

Hind legs long and slender, tibiæ with four stout spurs. Abdomen long and slender, just reaching the anal angle. In style of coloration the genus reminds us of *Caustoloma*, and more remotely of *Nematocampa*. The body and wings are yellow, with fawn colored costal spots, and the edges of the wings are stained with fawn. In size the only species yet known is intermediate between *Caustoloma* and *Nematocampa*. Its large, long, acute palpi, simple antennæ with triangular joints, and its non-angulated wings, will distinguish the genus.

Eurhinosea flavaria. 4 ♂, 2 ♀.

Body and wings deep ochreous yellow. Palpi brown on sides of second joint. Fore wings clear yellow, costa fawn brown at base, two costal brown spots in the middle of the wing, the inner oblique, the outer nearly straight. No lines in the middle area of the wing; a small discal dot (sometimes wanting), a minute dot on the origin of the third or lower median venule; outer edge of the wing below the apex broadly margined with fawn brown to, and enclosing, the anal angle, the band being as broad as the thorax. Hind wings concolorous with the fore wings; a rather large dark dot close to the origin of the first subcostal venule, a triangular marginal patch just below the apex; otherwise no markings. Beneath, from a large basal costal spot, proceeds a fine curved line across the wing, and with a much curved one within, forms a ringlet. Beyond the conspicuous dark discal dot a broad diffuse pale brown shade crosses the wing, slightly scalloped externally; the shade does not connect with the outer costal spot; the marginal shade is dark on the oblique upper edge, but is fainter towards the anal angle than on the upper side of the wing. A faint row of diffuse small spots between this shade and the middle shade. Hind wings with a very distinct discal dot. A narrow, fine, much curved line crosses the middle of the wing; another sinuate line midway between this and the margin; the part just below the apex is oblong rather than triangular, as above. Fringe brown on both wings, with darker spots on ends of venules beneath; towards anal angle of secondaries fringe becomes yellowish. The two ♀ and one ♂ are paler, without the marginal dark band, while the lines below are well marked, the ♂ median shade of primaries being represented by a very distinct sinuate line, with three rude ringlets on the inside of the line, and the fringe is yellowish; in another specimen the lines are much more distinct.

Length of body ♂, .45, ♀, .40 inch; fore wing ♂, .50, ♀, .50 inch. Sierra Nevada (Edwards).

This interesting species may be known by the non-angulated yellow wings, with the broad marginal shade, and the subtriangular spot on hind wing, and the large discal dots on hind wing on inner third of wing.

Sicya crocearia n. sp. 3 ♂, 4 ♀.

Sulphur yellow; palpi and orbits deep reddish orange; thorax sulphur yellow, concolorous with the primaries; hind wings pale yellow, a little deeper than the abdomen. Primaries crossed by two light brown lines, the inner (often obsolete) oblique, scarcely curved and bent at right angles on the costa; the outer runs straight from just beyond the middle of the inner edge of the wing to the costa, on which it forks, ending just before the apex; beyond this line the wing is pale fawn brown, the apical region clear yellow. Hind wings with a single sinuate reddish or brown line, beyond which the wing is tinged with reddish, while within the line it is inclined to be whitish. Beneath whitish yellow, primaries more yellow than secondaries; the outer line a broad reddish orange band, with the wing beyond tinged with the same color, the apical region yellowish; a brown or paler curved line on hind wings, with a few brown flecks beyond, though those are often wanting. Legs pale, a little darker at the ends of tibiæ, or broadly ringed with dark brown.

Length of body ♂, .45, ♀, .35–.50; of fore wing ♂, .55, ♀, .47–.72 inch. California (Edwards and Behrens); Nevada (Edwards).

The inner line is often obsolete, or represented by a few spots; the outer varying in depth of color, usually but little darker than the brown portion beyond. Hind wings sometimes yellowish, with a brown line. A large ♀ from California, received from Mr. Behrens, differs from the others in having the outer line on fore wings obsolete between the median vein and the costa, and the lines brown, and hind wings more yellowish and speckled with brown scales.

In a single ♂ specimen from California, the costa of fore wings is arched, the wings being much broader and fuller; a distinct dark triangular costo-apical spot, while the base of costa is reddish, the secondaries much more rounded, and the line nearer the middle of the wing, and distinctly scalloped, but I judge the three forms to be simple local varieties, as the markings vary considerably in this genus. The five Nevada individuals are smaller than the others, and with narrower wings. This species differs from *Sicya truncataria* Gn., which it very closely resembles, in the more sinuate outer line on the fore wings, while the margin of the wing is deeper brown. Whether these differences are permanent cannot be determined unless we have more material.

Hesperumia n. gen.

Closely related to *Angerona*, agreeing with it in the strongly pectinated antennæ, the branches reaching to the tip, and in the large, well developed head, which is quite free from the thorax; the palpi much the same, but a little larger and blunter. Fore wings more pointed at the apex, and less angulated in the middle of the outer edge. The subcostal venules are shorter, sent more direct to the costa, and the costal interspace narrower than in *Angerona*. Hind wings full, not sinuate, the sinus being almost obsolete. Hind legs as in *Angerona*, the spurs of the same relative size. The female is much smaller than the male, while in *Angerona* the female is considerably larger than the male. In its mode of coloration this genus recalls *Rumia*, hence our generic name.

Hesperumia ochreata n. sp.

Deep ochreous, with brown flecks, and a large discal ring. Head ochreous, becoming reddish on the sides and anterior edge of the front; palpi dark brown, especially on the tips, with ochreous hairs at base on under side; antennæ brown, concolorous with the palpi. Front of the thorax deep ochreous, hinder portion, abdomen and legs much paler. Fore wings deep ochreous, more or less flecked with brown, sometimes the flecks are wanting; two lines, one crossing the middle of the wing and forming a large discal ring larger than in the European *Rumia crategata*, and enclosing a pale dot; the line is a little sinuate, and is often obsolete, especially in rubbed specimens, leaving a distinct distal ring and costal spot just in front of it. An outer very sinuate row of spots, often obsolete, except on the costa. Wings brown.

Hind wings paler than fore wings, with no markings, but a little deeper ochreous towards the outer edge. Fringe concolorous with the rest of the wing.

Beneath on fore wings no lines or discal spot, but the outer costal brown spot is present, and there are brownish costal spots within. Hind wings same as above. Legs a little dusky at the femoro-tibial joints; tibiæ a little dusky.

Length of body ♂, .55, ♀, .50 inch; of fore wing ♂, .72, ♀, .62 inch. 1 ♂, 2 ♀, Sierra Nevada, Cal., and Nevada (Edwards).

Metrocampa virido-perlata n. sp. 1 ♂, 1 ♀.

More nearly allied to our eastern species than to the European, but still it differs in the two bands on fore wing being nearer together, the inner band crossing the base of the origin of the third median venule. Antennæ the same.

Though the moths expand equally, yet in both sexes the head is much smaller than in *perlata*, an unusual distinction, while in *perlata* and *margaritacea* the head of the ♂ (no ♀ of *margaritacea* for comparison) are of the same size. The Nevada species is also a little greener than our species. Red band below antennæ, as in *perlata*.

Until a large number of specimens are compared I shall consider the species distinct, though they would be easily confounded at first.

Length of body ♂, .50, ♀, .60 inch; fore wing ♂, .77, ♀, 1 inch.

Sierra Nevada, Cal., (Edwards).

Selidosema juturnaria Guen.

Alaska (J. Behrens); Colorado Terr., (Ridings, Coll. Amer. Ent. Soc.).

Tetracis parallelia n. sp.

Allied in general form to *T. truxaliata*. The two outer subcostal venules much shorter than in that species. A fresh specimen, though smaller (length of fore wing .42), from Mr. Behrens, is ochreous, though paler than in *T. truxaliata*, with deep reddish ochreous lines on fore wings. Angle of hind wings well marked, though much less distinct than in *T. truxaliata*.

California (Behrens).

Eutrapela falcata n. sp. 1 ♀.

A slighter, though not smaller, moth than *E. œgrotata*,[1] and with the wings much more angulated, and the apex of the fore wings much more falcate than in *E. transversata*, or any other species known to me. Antennæ slightly slenderer than in *E. transversata*. Pale ochreous. Head, body and wings, of the same hue. Fore wings with no lines, and with only a few scattered blackish speckles, a conspicuous black discal dot, and three subapical black spots, one just behind the costal edge. Hind wings with a few scattered specks and a distinct black discal dot. Beneath marked, just as above, the three subapical and discal spots being reproduced. Wings a little more densely speckled with black, and the fore wings a little deeper ochreous.

Length of body .65, fore wing .82 inch. California (Edwards).

This fine species may be at once known by the very acute falcate apex, the want of lines on the wings, and the three subapical large black spots. The front of the head is ochreous, like the rest of the body.

An egg retained on the end of the abdomen is apparently spherical, with numerous high, and very distinct longitudinal ridges.

Drepanodes Panamaria n. sp. 2 ♂.

This species differs structurally in some important characters from the more northern species known to me. The wings are a little shorter, and the apex much less falcate than usual; the first subcostal interspace is much shorter and smaller than in *D. varus* and *sesquilinea*, and all the venules sent off towards the outer edge of the wing are shorter than usual. The hind tibiæ are greatly swollen, nearly twice as much so as in *D. sesquilinea*, and the spurs are much shorter. Antennæ broadly pectinated, fully as much as usual. Body and wings pale yellow ochreous, and of the same shade as above and beneath, including the legs. Fore wings with traces of a narrow basal curved ferruginous line. An outer oblique pale ferruginous line straight in its course (not curved as usual), just below the apex. On the costa, just in front of the angle, is a geminate black spot, and another spot on the apex. Another larger spot between the first and second median venules, and a large round black patch on the inner angle. Beyond the outer line the wing is fawn brown, and also the hind wings; the latter are crossed by a single faint narrow ferruginous straight line. Both wings have scattered black speckles. Beneath as above, except that there are no lines, but the brownish margins of both wings are as well marked as above. Minute discal dots above and below, on both pairs of wings. Fore tibiæ a little dusky.

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[1] I regard *Cherodes* as congeneric with *Eutrapela clemataria* Hübner, and *nubilata* Pack.; *C. œgrotata* (Guen.) should therefore fall into Hübner's genus *Entrapela*.

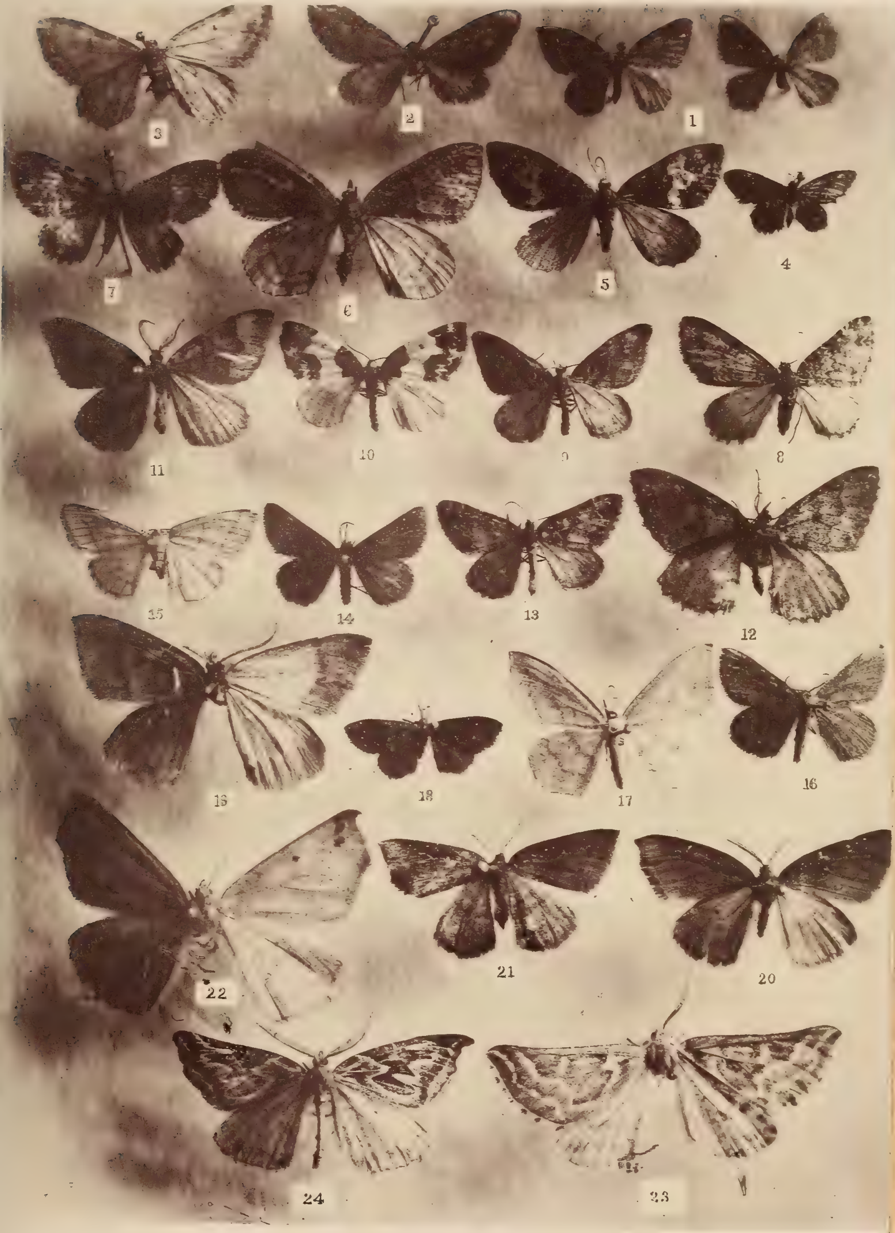
Length of body .45, of fore wings .50 inch. Panama (Edwards).

Recognized, besides its singular structural features, by the edge of both wings being broadly shaded with pale fawn brown.

This description of a Panama species of *Drepanodes* is appended, as the genus may yet occur in southern California.

EXPLANATION OF PLATE 1.

Fig. 1, bis. Larentia 12-lineata Pack.
“ 2. Eupithecia Nevadata Pack.
“ 3. Larentia cretaceata Pack.
“ 4. Hyria occidentaria Pack.
“ 5. Hypsipetes albifasciata Pack.
“ 6. Cidaria glaucata Pack.
“ 7. Melanippe Kodiakata Pack.
“ 8. Larentia cumatilis (Grote).
“ 9. Phibalapteryx carnata Pack.
“ 10. Melanthia brunneiciliata Pack.
“ 11. Coremia lignicolorata Pack.
“ 12. Scotosia Californiata Pack.
“ 13. Cidaria leoninata Pack.
“ 14. Acidalia rubrolinearia Pack.
“ 15. Acidalia subalbaria Pack.
“ 16. Acidalia Californiaria Pack.
“ 17. Acidalia 5-linearia Pack.
“ 18. Acidalia rubromarginaria Pack.
“ 19. Selidosema juturnaria Guen.
“ 20. Tephrosia falcataria Pack.
“ 21. Tephrosia ferruginosaria Pack.
“ 22. Eutrapela falcata Pack.
“ 23. Gorytodes trilinearia Pack.
“ 24. Gorytodes uncanaria Guen.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PACKARD, PHALÆNIDÆ.

Dr. T. M. Brewer presented by title the following paper, which will appear in the Society's Memoirs: — Catalogue of the Birds of Western and North Western Mexico, based on the collections of Grayson, Xantus and Bischoff; with the notes of Grayson and his biographies of several of the species. By Geo. N. Lawrence.

Prof. W. H. Niles read an extract from a letter from Mr. A. T. Wing, concerning the continuance of the spontaneous fractures and movements of rock, at the quarry of Mr. W. N. Flynt, at Monson, Mass.

An account of the character of some of the phenomena at the quarry had been previously communicated to the Society by Prof. Niles, and was published in the Proceedings, Vol. XIV., pp. 80–87. As there stated, the quarry is on a small hill near the village of Monson. The rock is gneiss, dipping westward at an angle of about eighty degrees. Joints running nearly parallel to the general surface of the hill divide the rock into beds varying in thickness from one inch and a half to several feet. These beds extend for long distances unbroken by any divisional planes, and on that account are remarkably well adapted to manifest any lateral pressure to which they may be subjected. That there is a lateral force exerted powerfully in north and south directions is evident from the facts. When portions of the beds are removed by quarrying the force which was originally distributed throughout the extent of the beds is concentrated upon the remaining parts. When the force becomes, by this concentration, greater than the strength of the rock, as is often the case, the rock is broken, often upheaved, and sometimes with violence and attended by explosions. He had requested Mr. Wing to observe and report such additional phenomena as might occur during his absence last year, and the present letter was in accordance therewith.

" The spontaneous fractures or breaks have been more frequent and on a larger scale during the past summer and autumn, than for any previous season, which is accounted for, I think, by the fact that the quarries have been worked more extensively. One occurred in the latter part of June, in the new quarry on the west side of the ridge, near where you took a sketch of a break, in the autumn of 1871, and again in the spring of 1872. The break extended about two hundred and seventy-five feet, and was about seventy feet back from the working face, and parallel to it. About ten thousand tons of rock were moved southward three-fourths of an inch. The break extended perpendicularly through several sheets or layers. The north end of the mass did not break from the parent rock. But few days or evenings passed that a fracture did not occur and usually accompanied by reports. Within a few days, while a north and south split of about one hundred feet in length was being made in the old quarry, the stone suddenly freed itself, and the liberated side moved northward five-eighths of an inch, the south end still remaining fast. This liberated stone came in contact, in its movement, with a projection, causing the crack to deflect to the north-east and thirty feet beyond the wedges, breaking loose one hundred tons of rock in addition to that split off by the wedges, showing conclusively the north and south pressure. From the above observations I note the following facts, viz.: —

"In June the mass of ten thousand tons expanded southward down the incline, the north or upper end remaining joined to the main ledge. At the lower end the amount of movement was three-fourths of an inch, but this movement gradually decreased in amount northward till it was imperceptible at the upper end.

"In November, a mass of three hundred tons expanded north or up the incline five-eighths of an inch, the south end being fast to the parent rock. The same decrease in the amount of movement was observed as in the break of June.

"I notice, furthermore, that the deeper we go in the rock the greater the amount of expansive movement."

Dr. Brewer announced the donation of nine species of birds from Chas. E. Aiken, Esq., and of the rare *Micrathene Whitneyi* and *Harporhynchus crissalis* from Capt. Charles Bendire. The thanks of the Society were voted to both gentlemen for these valuable gifts.

May 21, 1873.

The President in the chair. Twenty persons present.

Mr. Wm. T. Brigham, nominated at the previous meeting, was elected to fill the vacancy in the Committee on Geology.

The following papers were read: —

CATALOGUE OF THE ORNITHOLOGICAL COLLECTION OF THE BOSTON SOCIETY OF NATURAL HISTORY. PART II. FALCONIDÆ. BY ROBERT RIDGWAY.

The following list of the species and specimens of Falconidæ contained in the Museum of the Society is intended as one of a series of Catalogues which it is the plan of the Society to continue as fast as a careful preparation of the lists, based upon a thorough revision of the specimens, will permit. The series was commenced by a catalogue of the Spheniscidæ, by Prof. A. Hyatt, published in 1871.[1]

Acknowledgements are due from the author to T. T. Bouvé, Esq., the courteous President of the Society, and to Dr. T. M. Brewer, Chairman of the Committee on Birds, for invaluable assistance which they rendered him in the preparation of this work, by kindly furnishing every facility needed. He is also under many obligations to Mr. J. H. Gurney, Curator of the Norwich Museum, England, and well known as the first authority upon Raptorial birds, for very much information concerning the identification of certain Old World species.

The numbers affixed to the names in this catalogue correspond with those of Gray's Hand List of Birds,[2] the nomenclature of which is mainly adopted. The arrangement, however, expresses the peculiar views of the present author, so far as they have become fixed, regarding the classification of the family.

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[1] Proc. Bost. Soc. Nat. Hist., XIV., 237.

[2] Hand List of the Genera and Species of Birds, distinguishing those contained in the British Museum. By George Robert Gray, Assistant Keeper of the Zoological Collections. Part I. Raptores, Fissirostres, Tenuirostres and Dentirostres. London, 1869.

Family FALCONIDÆ.

Subfamily FALCONINÆ.

(Group *Falcones.*)

Falco (Hierofalco) sacer Forst.

a. var. *candicans* Gmel. (158.)

1438, ♂ ad. North Europe. Lafr. Coll., No. 435.
1440, ♀ " Greenland. " " " 436.

b. var. *islandicus* Brün. (159.)

1441, ♀ ad. Greenland. Lafr. Coll., No. 437.
1442, ♀ " " ? " " " 438.
1443, — juv. " ? " " " 439.

c. var. *labradora* Aud.

11, ♂ ad. Labrador?

Falco (Hierofalco) lanarius Linn.

a. var. *mexicanus* Schleg. (179.)

1438, ♂ juv. Mexico. Lafr. Coll., No. 434.

b. var. *polyagrus* Cassin. (178.)

10, ♀ ad. Sonoma Co., California. From Sm. Institution.
— ♂ juv. Sherman, Wyoming Ter.; C. N. Holden.

Falco (Hierofalco) cervicalis Licht. (172.)

1444, ♂ ad. Cape of Good Hope. Lafr. Coll., No. 440.
1445, ♀ " South Africa. " " " 441.
1446, ♂ " " " " " " 442.
1447, ♂ juv. Cape of Good Hope. " " " 443.
1448, ♀ ad. " " " ? " " " 444.

Falco communis Gmel.

a. var. *communis* Linn. (163.)

1430, ♂ ad. Europe. Lafr. Coll., No. 426.
1431, ♀ " " " " " 427.
1432, ♂ juv. " " " " 428.
1433, ♀ " " " " " 429.
9528, ♂ ad. " " " " 8452.

b. var. *anatum* Bonap. (166 and *sub* 165.)

5,	♀ juv.	Vermont.	Tracy Sheaf.
55,	♀ "	North America.	
430,	♂ ad.	" "	?
——	♂ "	" "	?
1437,	♂ juv.	" "	Lafr. Coll., No. 433.
——	♂ "	" "	? Dr. A. Binney.

c. var. *melanogenys* Gould. (167.)

1435,	♂ ad.	Australia.	Lafr. Coll., No. 431.
1436,	♀ "	"	" " " 432.

Falco aurantius Gmel. (185.)

1461,	♀ ad.	Brazil.	Lafr. Coll., No. 457.
1462,	♀ juv.	"	" " " 458.

Falco rufigularis Daud. (184.)

1463,	♂ ad.	Brazil.	Lafr. Coll., No. 459.
1464,	♀ "	Bolivia.	" " " 460.
1465,	♂ "	———.	" " " 461.
8453,	♀ "	———.	
——	♂ "	———.	
——	♀ "	Tehuantepec.	F. Sumichrast.

Falco (Hypotriorchis) cuvieri Smith. (183.)

1460,	♀.	Cape of Good Hope.	Lafr. Coll., No. 456.

Falco (Hypotriorchis) severus Horsf. (182.)

1453,	♂ ad.	Manilla.	Lafr. Coll., No. 449.

Falco (Hypotriorchis) lunulatus Leath. (181.)

1454,	♀ juv.	Australia.	Lafr. Coll., No. 450.
1455,	♂ "	"	" " " 451.
——	——	"	Smithsonian Institution (No. 13860.)

Falco (Hypotriorchis) subbuteo Linn. (180.)

1456,	ad.	Europe.	Lafr. Coll., No. 452.
1457,	"	"	" " " 453.
1458,	juv.	"	" " " 454.

Falco (Dissodectes) ardesiacus Vieillot.

1469, ♀ ad. Senegal. Lafr. Coll., No. 465.

Falco (Æsalon) lithofalco Gmel.

a. var. *lithofalco* Gmel. (192.)

1466, ♂ ad. Europe. Lafr. Coll., No. 462.
1467, ♂ " " " " " 463.
1468, ♀ " " " " " 464.
452, ♂ juv. " J. F. Bumstead. (Labelled *F. subbuteo.*)

b. var. *columbarius* Linn. (193.)

1459, ♀ ad. North America? Lafr. Coll., No. 455. (Labelled "*F. subbuteo*, young, Europe.")
1470, ♂ " Cuba. Lafr. Coll., No. 466. (Very dark.)
1471, ♀ " Guadeloupe " " 467.
♂ " San José, California. Jan., 1871. Wm. Holden.
7, ♂ " Boston. Dr. A. Binney.
73, ♂ juv. Dane Co., Wisconsin. S. Kumlein.
— ♂ " " " " " Sept. 4, 1869.
♀ " " " " " Sept. 6, 1869.
71, ♀ ad. Sonoma Co., California.
♀ " ——— — ——— ?
♀ " Spanishtown, Jamaica. W. T. March.
72, ♀ " Boston. Dr. Binney.

Falco (Rhynchofalco[1]) femoralis Temm. (194.)

1472, ♂ ad. Brazil. Lafr. Coll., No. 468.
1473, ♂ " " " " " 469.
1474, ♂ juv. " " " " 470.
♀ ad. South America? J. A. Reynolds.
♀ juv. " " ? A. Vattemare.

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[1] *Rhynchofalco* Nobis. Similar to *Hypotriorchis*, but frontal scutellæ of the tarsus and toes large, well-defined, and scarcely interrupted in the region of the digito-tarsal joint. Two outer primaries with inner webs cut. Bill very strong, the cere more elongated than in *Hypotriorchis* and allied subgenera, its length on top being about one-third the chord of the culmen. Type, *Falco femoralis* Temminck.

Falco (Tinnunculus) alaudarius Gmel.

a. var. *alaudarius* Gmel. (203.)

1475,	♂ ad.	Europe.	Lafr. Coll., No. 471.
1476,	♀ "	"	" " " 472.
1477,	♂ juv.	"	" " " 473.
1478,	♂ ad.	India.	" " " 474.
——	♀ "	Europe.	Dr. Bumstead.
——	♀ "	"	Dr. S. Cabot.

b. var. *rupicolæformis* Würt. (*sub* 203.)

9530,	——.	South Africa.	Lafr. Coll., No. 8454.

c. var. *japonicus* Schleg. (*sub.* 203.)

1479,	♂ ad.	Japan.	Lafr. Coll., No. 475.
1480,	♀ "	"	" " " 476.

Falco (Tinnunculus) rupicolus Daud. (204.)

1481,	♂ ad.	Cape of Good Hope.	Lafr. Coll., No. 477.
1482,	♂ "	South Africa.	" " " 478.
1483,	♀ "	"	" " " 479.

Falco (Tinnunculus) rupicoloides Smith.

1484,	♀ ad.	Africa.	Lafr. Coll., No. 480.

Falco (Tinnunculus) punctatus Cuv. (206.)

1486,	♂ juv.	Madagascar.	Lafr. Coll., No. 484.
1489,	♀ ad.	"	" " " 485.
1490,	♀ juv.	"	" " " 486.
1491,	♀ "	"	" " " 487.
1492,	♀ "	"	" " " 488.

Falco (Tinnunculus) cenchroides Vig. (209.)

1485,	♂ ad.	Australia.	Lafr. Coll., No. 481.
1486,	♂ juv.	"	" " " 482.
——	♀ ad.	"	Smithsonian Institution (No. 13870).

Falco (Tinnunculus) sparverius Linn. (216 *excl. syn.*)

a. var. *sparverius* Linn.

—— ♂ ad. Guatemala. Van Patten.
—— ♂ " " "
—— ♂ " " "
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—— ♂ " " "
—— ♂ " Costa Rica (Carmiol). Smithsonian Institution.
9531, ♂ " North America. Lafr. Coll., No. 8455.
1497, ♂ " " " " " " 493. ("*F. sparveroides.*")
—— ♂ " North America?
—— ♂ juv. Guatemala. Van Patten.
—— ♂ " " "
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1505, ♀ " Mexico. Lafr. Coll., No. 501.
1504, ♀ " North America. Lafr. Coll., No. 500.
—— ♀ " Yreka, California, May 21. (Vuille.) Smithsonian Institution (No. 21328).
—— ♀ juv. United States. Lafr. Coll., No. 496.
—— ♀ " North America.

b. var. *isabellinus* Swains. (*sub.* 216.)

1493, ♂ ad. "Cuba"? Lafr. Coll., No. 489.
1499, ♂ " Georgia. " " " 495.

c. var. *australis* Ridgw.

1496, ♂ ad. Brazil. Lafr. Coll., No. 492.
1498, ♂ " " " " " 494.
8459, ♀ " " " " " ?

d. var. *dominicensis* Gmel. (218 *excl. syn.*)

1502, ♂ ad. "North America." Lafr. Coll., No. 498. (Locality erroneous!)
—— ♂ ad. Porto Rico (R. Swift). Smithsonian Institution (No. 36438).
—— ♀ ad. Porto Rico. Bryant Coll., No. 171.

Falco (Tinnunculus) leucophrys Ridgw.

1495, ♂ ad. Cuba. Lafr. Coll., No. 491.
1503, ♂ juv. " ? " " " 499. ("United States.")
—— ♀ " " (Remedios; N. H. Bishop.) Smithsonian Institution (No. 34235).

Falco (Tinnunculus) sparverioides Vig. (*sub* 218.)

1494, ♂ juv. Cuba. Lafr. Coll., No. 490.
1501, ♀ " " ? " " " 497. ("North America.")
—— ♀ " " (Monte Verde; Wright.) Smithsonian Institution (No. 23545).

Falco (Tichornis) cenchris Naum. (215.)

1487, ♂ ad. Morea. Lafr. Coll., No. 483.

Falco (Erythropus) vespertinus Linn. (213.)

1506, ♂ ad. Russia. Lafr. Coll., No. 502.
1507, ♀ " Austria. " " " 503.

Falco (Chicquera) chicquera Daud. (195.)

1449, ♂ ad. Jondia. Lafr. Coll., No. 445.
1450, ♀ " Java. " " " 446.

Falco (Chicquera) ruficollis Swains. (196.)

1451, ♂ ad. Senegal. Lafr. Coll., No. 447.
1452, ♀ " " " " " 448.

Ieracidea berigora (Vig.). (199.)

1424, juv. Australia, Lafr. Coll., No. 420.
1425, — " " " " 421.

Ieracidea occidentalis Gould. (200.)

1426, ♂ ad. Australia. Lafr. Coll., No. 422.
1427, ♀ " " " " " 423.

Ieracidea novæzealandiæ (Gmel.) (201.).

1428, ♂ — Auckland. Lafr. Coll., No. 424.
1429, —— " " " " 425.

Ierax cærulescens (Linn.). (219.)

1509, ♂ ad. India. Lafr. Coll., No. 504.
1510, ♂ " Sumatra. Lafr. Coll., No. 505.
—— ♂ " ——— ? Dr. S. Cabot. ("*I. maylayensis.*")

Ierax eutolmos Hodgs.? (220.)

1510,^{bis} ♂ ad. India. Lafr. Coll., No. 506. ("*bengalensis*, Briss.")

Ierax sericeus Kittl. (222.)

1511, ♂ ad. Philippines. Lafr. Coll., No. 507.

(Group *Polybori.*)

Milvago chimango (Vieill.). (30.)

1702, ♂ ad. Chile. Lafr. Coll., No. 697.
—— — " " ? Dr. Vattemare.

Milvago chimachima (Vieill.). (29.)

1703, ♂ ad. Brazil. Lafr. Coll., No. 698.
1704, ♀ " " " " " 699.
1705, ♂ juv. " " " " 700.
—— — " " ? Dr. U. Cragin. ("*Ibycter fasciatus* Spix.")

Phalcobænas megalopterus (Meyen). (32.)

1706, ♀ ad. Bolivia. Lafr. Coll., No. 701.
1707, ♀ juv. Chile. " " " 702.

Polyborus tharus (Mol.).

a. var. *tharus* Mol. (35.)

1709, ♀ ad. Brazil. Lafr. Coll., No. 704.
1710, ♀ juv. " " " " 705.
—— ♀ ad. ——— T. Vattemare.
—— — " South America. Smithsonian Institution (No. 13924).

b. var. *auduboni* Cass. (*sub* 35.)

1708, ♂ ad. "Brazil." Lafr. Coll., No. 703. (Locality erroneous!)
—— ♂ " Cape St. Lucas. Smithsonian Institution (No. 29454).

Ibycter americanus (Bodd.). (25.)

1699, ♂ ad. Brazil. Lafr. Coll., No. 694.
1700, ♀ " " " " " 695.
—— ♂ " " ? F. W. Cragin.

Ibycter (Daptrius) ater Vieill. (27.)

1701, — ad. South America. Lafr. Coll., No. 696.

(Group *Micrastureæ.*)

Micrastur semitorquatus (Vieillot). (290.)

1554, ♀ ad. Brazil. Lafr. Coll., No. 549.
1555, ♀ " " " " " 550.

Micrastur mirandollei (Temm.). (291.)

1553, ♂ ad. Brazil. Lafr. Coll., No. 548.

Micrastur ruficollis (Vieill.). (292.) (See Appendix.)

1556, ♂ ad. Cordilleras. Lafr. Coll., No. 551. (Labelled "*concentricus* Illig.")
1558, — juv. Brazil. " " " 553. (*Rufous phase.*)
1559, ♂ " " " " " 554. " "
1560, ♀ ad. " " " " 555. " "
1561, ♀ trans. " " " " 556. " "
1562, ♀ juv. " " " " 557. " "
—— — ad. Guatemala. Van Patten. (*Gray phase.*)
—— — juv. " " "
—— — " ——— ——— (*Rufous phase.*)

Micrastur concentricus (Illig.). (*sub* 294.)

1557, ♀ ad.	South America.	Lafr. Coll., No. 552.

(Group *Herpetothereæ.*)

Herpetotheres cachinnans (Linn.). (298.)

1317, — ad.	Brazil.	Lafr. Coll., No. 315.
1318, — “	Cayenne.	“ “ “ 316.
—— — “	Brazil.	

Subfamily BUTEONINÆ.

(Group *Pandiones.*)

Pandion haliætus (Linn.).

a. var. *haliætus* Linn. (131.)

1303, ——	Europe.	Lafr. Coll., No. 301.
1304, ——	“	“ “ “ 302.

b. var. *carolinensis* Gmel. (132.)

1306, — ad.	America.	Lafr. Coll., No. 304.
1307, — “	“	“ “ “ 305.
—— — “	No label.	
—— — “	“	
— juv.	“	
—— — ad.	Massachusetts?	

c. var. *leucocephalus* Gould. (133.)

1305, ——	Australia.	Lafr. Coll., No. 303.

Nauclerus forficatus (Linn.). (249.)

1412, — ad.		Lafr. Coll., No. 408.

(Group *Pernes.*)

Pernis apivorus (Linn.). (237.)

1389, ——	India.	Lafr. Coll., No. 385.
1390, ——	“	“ “ “ 386.
1391, ——	“	“ “ “ 387.
1392, ——	“ ?	“ “ “ 388.

Pernis ptilorhynchus (Temm.). (239.)

1393, —— ——— Lafr. Coll., No. 389.

Baza lophotes (Temm.). (227.)

1394, ♂ ad. India. Lafr. Coll., No. 390.
1395, ♀ " " " " " 391.

Cymindis (Aviceda) subcristatus (Gould). (231.)

1396, ♂ ad. Australia. Lafr. Coll., No. 392.
1397, ♀ " " " " " 393.

Cymindis (Aviceda) verreauxi (Lafr.). (234.)

1399, —— ——— Lafr. Coll., No. 395.

Cymindis cayennensis (Gmel.). (252.)

1404, ♂ ad. Brazil. Lafr. Coll., No. 400.
1405, ♀ " South America. Lafr. Coll., No. 401.
1406, — juv. " " " " 402.
—— — ad. " " " 8450.

Regerhinus uncinatus (Illig.) (253.)

1407, juv. Brazil. Lafr. Coll., No. 403. (*Transition dress.*)
1408, " " " " " 404. " "
1409, " Bogota. " " " 405. (*Buff-collared plumage.*)
1410, " Tropical America. Lafr. Coll., No. 406. (*White-collared plumage.* Labelled "Western North Am.")
1411, " South America. Lafr. Coll., No. 407. (*Melanistic plumage.*)
—— " South America. Lafr. Coll., No. 8451. (*Rufous-collared plumage.*)

(Group *Elani.*)

Elanus leucurus.

a. var. *leucurus* Vieill. (263.)

1418, — ad. Paraguay. Lafr. Coll., No. 414.
35, — " Chile.
—— — " " Smithsonian Institution (No. 13914).
—— ♀ juv. Orizaba. " " (No. 37693).

b. var. *axillaris* Lath. (261.)

1417, ad.	Australia.	Lafr. Coll., No. 413.

Elanus melanopterus.

b. var. *minor* Bonap. (259.)

1413, ad.	Africa.	Lafr. Coll., No. 409.
1414, juv.	“	“ “ “ 410.
1415, “	“	“ “ “ 411.
1416, —	“	“ “ “ 412.

Elanus (Gampsonyx) swainsoni (Vig.). (265.)

1419, ♂ ad.	South America.	Lafr. Coll., No. 415.
1420, ♀ “	“	“ “ “ 416.
—— — “	No label.	

(Group *Ictiniæ.*)

Ictinia plumbea (Vieill.). (267.)

1421, ad.	Brazil.	Lafr. Coll., No. 417.
1422, “	“	“ “ “ 418.
1423, juv.	“	“ “ “ 419.
—— ad.	“ ?	J. N. Reynolds.

Harpagus bidentatus (Lath.). (224.)

1572, ♂ ad.	South America.	Lafr. Coll., No. 508.
1513, ♀ juv.	Brazil.	“ “ “ 509.

Harpagus diodon (Temm.). (225.)

1514, — ad.	Brazil?	Lafr. Coll., No. 510.
1515, ♀ “	Guiana.	“ “ “ 511.
1516, — juv.	Brazil.	“ “ “ 512.
9533, — “	“	“ “ “ 8457.

Rostrhamus sociabilis (Vieill.). (251.)

1400, — ad.	Brazil.	Lafr. Coll., No. 396.
1402, ♂ “	“	“ “ “ 398.
1403, — juv.	“	“ “ “ 399.

Rostrhamus hamatus (Illig.). (*sub* 251.)

1400, — ad.	Brazil?	Lafr. Coll., No. 397.

(Group *Circeæ.*)

Circus æruginosus (Linn.). (356.)

1666, ad.	Europe.	Lafr. Coll., No. 661.
1667, juv.	“	“ “ “ 662.
1668, “	“	“ “ “ 663.
1669, “	“	“ “ “ 664.

Circus ranivorus (Daud.). (357.)

1674, ♀ ad.	South Africa.	Lafr. Coll., No. 669.

Circus spilonotus Kaup. (360.)

1676, ♀ juv.	Asia.	Lafr. Coll., No. 671.

Circus maillardi J. Verr. (361.)

1675, ♀ ad.		Lafr. Coll., No. 670.

Circus jardinii Gould. (363.)

1681, ♂ juv.	Australia.	Lafr. Coll., No. 676.
1682, ♀ ad.	“	“ “ “ 677.

Circus cyaneus.

a. var. *cyaneus* Linn. (364.)

1689, ♂ ad.	Europe.	Lafr. Coll., No. 684.
1690, ♂ “	“	“ “ “ 685.
1691, ♀ “	“	“ “ “ 686.
1692, ♀ “	Algeria.	“ “ “ 687.
—— ♀ “	Europe.	S. Lyman.

b. var. *hudsonius* Linn. (365.)

—— ♂ ad.	No label.	
—— ♂ “	“	
—— ♀ “	Wisconsin.	T. Kumlein.
—— ♂ juv.	No label.	

—— ♀ juv. California. F. Gruber. (4329.)
—— ♂ ad. New England.
141, ♂ " No label.
—— ♀ juv. New England. Dr. Binney.

c. var. *cinereus* Vieill. (368.)

1696, ♂ ad. Brazil. Lafr. Coll., No. 691. ("*C. histrionicus* Quoy.")
—— ♂ " " ? A. Vattemare.
—— ♂ juv. " ? "

Circus melanoleucus (Gmel.). (366.)

1693, ♂ ad. India. Lafr. Coll., No. 688.
1694, ♂ " Ceylon. " " " 689.

Circus maurus (Temm.). (367.)

1695, ♂ ad. Africa. Lafr. Coll., No. 690.

Circus cinerarius (Mont.).

1683, ♂ ad. Europe. Lafr. Coll., No. 678.
1684, ♀ " " " " " 679.
1685, ♀ juv. " " " " 680.
1686, — — " " " " 681. (*Melanistic.*)
1687, — — " " " " 682. "

Circus pallidus Sykes.

1688, ♂ ad. Manilla. Lafr. Coll., No. 683. ("*C. swainsoni* Smith.")

Circus mulleri Heugl.

1671, ♂ juv. Lafr. Coll., No. 666.
1672, ♀ — " " " 667. (*Melanistic.*)

Circus macropterus Vieill. (371.)

1677, ♀ ad. South America. Lafr. Coll., No. 672.
1678, ♂ " " " " " 673.
1679, ♀ " " " " " 674.
1680, ♀ " " " " " 675.

Circus gouldi Bonap. (*sub* 371.)

1673, juv. Marquesas. Lafr. Coll., No. 668.

Circus poliopterus Tsch. (372.)

1697, ♂ ad. Paraguay. Lafr. Coll., No. 692. ("*C. histrionicus* Quoy.")
1698, ♀ ad. Paraguay. Lafr. Coll., No. 693. ("*C. histrionicus* Quoy.")

(Group *Nisi.*)

Nisus (Astur) palumbarius.

a. var. *palumbarius* Linn. (268.)

1569, ♀ ad. Europe. Lafr. Coll., No. 564.
1570, ♀ " " " " " 565.
1571, ♂ juv. " " " 566.
1572, ♀ " " " " " 567.

b. var. *atricapillus* Wils. (269.)

—— — ad. Locality unknown.
—— ♂ juv. " "
14, — ad. New England.
—— — " "
—— — juv. "

Nisus (Astur) melanoleucus (Smith). (270.)

1567, ♀ ad. Port Natal. Lafr. Coll., No. 562.
1568, ♀ juv. " " " " 563.

Nisus (Astur) novæhollandiæ Gmel. (276.)

1563, ♂ ad. Australia. Lafr. Coll., No. 568.
1565, ♂ " " " " " 560.
—— — " " Smithsonian Institution (No. 13831).

Nisus (Astur) rayi Vig. and Horsf. (277.)

1564, ♀ ad. Australia. Lafr. Coll., No. 559.
1566, ♀ ad. " " " " 561.

Nisus fringillarius (Ray). (299.)

1635,	♂ ad.	Europe.	Lafr. Coll., No. 630.
1636,	♂ “	“	“ “ “ 631.
1637,	♂ “	“	“ “ “ 632.
1638,	♂ juv.	“	“ “ “ 633.
1639,	♂ “	“	“ “ “ 634.
1640,	♀ “	“	“ “ “ 635.
——	♂ “	“	Verreaux.
——	♂ ad.	No label.	
——	♂ juv.	“	
——	♂ “	“	
——	♀ “	“	
——	♀ ad.	“	
——	♀ “	Europe.	Dr. Bumstead.

Nisus rufiventris Smith. (300.)

1650,	♂ ad.	Cape of Good Hope.	Lafr. Coll., No. 645.
1651,	♀ “	Abyssinia.	“ “ “ 646.
1652,	♀ “	“	“ “ “ 647.

Nisus tachiro (Daud.). (301.)

1597,	♂ juv.	Abyssinia.	Lafr. Coll., No. 592.
1598,	♀ “	“	“ “ “ 593.
1599,	♀ “	“	“ “ “ 594.
? 1600,	— “	“	“ “ “ 594 *bis.*

Nisus toussenelli Verr. (302.)

1605,	♂ ad.	Africa.	Lafr. Coll., No. 600.
1606,	♀ juv.	“	“ “ “ 601.

Nisus erythronemius (Gray). (305.)

1648,	♂ juv.	Brazil.	Lafr. Coll., No. 643.
1649,	♂ ad.	“ ?	“ “ “ 644.

Nisus madagascariensis (Verr.). (308.)

1642,	♂ ad.	Madagascar.	Lafr. Coll., No. 637.
1643,	♂ juv.	“	“ “ “ 638.

Nisus cooperi.

a. var. *cooperi* Bonap. (312.)

1644, ♂ ad. North America. Lafr. Coll., No. 639.
1645, — — “ “ “ “ 640.
1646, ♀ juv. “ “ “ “ 641.
1647, ♀ “ “ “ “ “ 642.
—— ♂ ad. “
17, ♂ “ “ Dr. Binney.
—— ♂ juv. “
—— ♀ “ Wisconsin. T. Kumlein.
171, ♂ “ Massachusetts. E. Samuels.

b. var. *mexicanus* Swains. (313.)

1581, ♂ ad. Mexico. Lafr. Coll., No. 576.
1582, ♂ “ “ “ “ “ 577.

Nisus pileatus.

a. var. *pileatus* Max. (315.)

1575, ♀ juv. Brazil. Lafr. Coll., No. 570.
1576, ♀ “ “ “ “ “ 571.
1577, ♂ ad. “ “ “ “ 572. (Labelled “*poliogaster* Temm.”)
1578, ♂ ad. Brazil. Lafr. Coll., No. 563. (Labelled “*poliogaster* Temm.”)
1583, ♂ juv. Brazil? Lafr. Coll., No. 578. (Labelled “Mexico.”)

b. var. *bicolor* Vieill. (318.)

1579, ♂ juv. Cayenne. Lafr. Coll., No. 574. (Labelled “*poliogaster* Temm.”)
1580, ♂ juv. Cayenne. Lafr. Coll., No. 580. (Labelled “*poliogaster* Temm.”)

Nisus tinus (Lath.). (320.)

1653, ♂ ad. Brazil. Lafr. Coll., No. 648.
1654, ♀ “ Merida. “ “ “ 649.
1655, ♀ “ Cayenne. “ “ “ 650.

Nisus virgatus (Temm.). (322.)

1607, — ad.	Calcutta.	Lafr.	Coll.,	No.	602.	
1608, — "	India.	"	"	"	603.	
1609, — juv.	"	"	"	"	604.	
1610, — "	"	"	"	"	605.	
1615, ♂ ad.	"	"	"	"	610.	(Labelled " South America.")

Nisus minullus (Daud.). (323.)

1656, ♂ juv.	South Africa.	Lafr.	Coll.,	No.	651.
1657, ♀ ad.	"	"	"	"	652.
1658, ♀ juv.	"	"	"	"	653.

Nisus torquatus Cuv. (327.)

1622, ♀ ad.	Timor.	Lafr.	Coll.,	No.	617.
1623, ♀ juv.	"	"	"	"	618.

Nisus cirrhocephalus (Lath.?). (329?)

1624, ♂ ad.	Australia.	Lafr.	Coll.,	No.	619.
1625, ♂ juv.	"	"	"	"	620.
1626, ♀ "	"	"	"	"	521.

Nisus approximans (Vig. & Horsf.). (330.)

1616, ♂ ad.	Australia.	Lafr.	Coll.,	No.	611.
1617, ♂ "	"	"	"	"	612.
1618, ♀ "	"	"	"	"	613.
1619, ♂ juv.	"	"	"	"	614.
1620, ♀ "	"	"	"	"	615.
1621, ♀ "	"	"	"	"	616.

Nisus rufitorques (Peale). (331.)

—— ♂ ad. Feejee Islands. Smithsonian Institution (No. 13851).

Nisus trinotatus (Bonap.). (337.)

1627, ♂ ad.	Java.	Lafr.	Coll.,	No.	622.
1628, ♀ "	"	"	"	"	623.
1629, ♀ juv.	India.	"	"	"	624.

Nisus gabar (Daud.). (342.)

1659, ♂ ad. Senegal. Lafr. Coll., No. 654.
1660, ♀ " Abyssinia. " " " 655.
1661, ♀ " Senegal. " " " 656.
1662, ♀ juv. " " " " 657.
1663, ♀ " Cape of Good Hope. " " " 658.

Nisus niger (Vieill.). (343.)

1664, ♂ ad. East Africa. Lafr. Coll., No. 659.
1665, ♀ " " " " " 660.

Nisus sphenurus Rüpp. (344.)

1600, ♀ ad. Abyssinia. Lafr. Coll., No. 595.
1601, ♂ " " " " " 596. ("*A. brachydactylus.*")
1602, ♂ trans. Senegal. Lafr. Coll., No. 597. ("*A. brachydactylus.*")
1603, ♂ juv. " " " " 598. " "
1604, ♂ " " " " " 599. " "
9538, ♂ ad. " " " " 8462. " "
9537, —juv. Abyssinia. " " " 8461.

Nisus badius (Gmel.). (347.)

1611, ♂ ad. Calcutta. Lafr. Coll., No. 606.
1612, ♀ " India. " " " 607.
1613, — trans. " " " " 608.
1614, —juv. " " " " 609.

Nisus soloënsis (Horsf.). (348.)

1630, ♂ ad. Java. Lafr. Coll., No. 625.
1631, ♀ " " " " " 626.
1632, ♂ juv. " " " " 627.
1633, ♀ " " " " " 628.

Scelospiza francesii (Smith). (349).

1634, ♀ ad. Sumatra. Lafr. Coll., No. 629.

Melhierax musicus (Daud.). (253.)

1589, ♂ ad.	Cape of Good Hope.	Lafr. Coll., No.	584.
1590, ♂ juv.	South Africa.	“ “ “	585.
1591, ♀ ad.	Cape of Good Hope.	“ “ “	586.

Melhierax polyzonus (Rüpp.). (354.)

1592, ♂ ad.	Africa.	Lafr. Coll., No.	587.
1593, ♀ “	Senegal.	“ “ “	588.
1594, ♀ “	“	“ “ “	589.
1595, ♂ juv.	Africa.	“ “ “	590.
1596, — “	“	“ “ “	591.
9536, — ad.	North Africa.	“ “ “	8460.

(Group *Geranospizæ.*)

Polyboroides radiatus (Scop.). (374.)

1711, ♂ ad.	South Africa.	Lafr. Coll., No.	706.
1712, ♂ “	Madagascar.	“ “ “	707.
1713, ♀ juv.	South Africa.	“ “ “	708.

Geranospiza gracilis (Temm.). (289.)

1586, ♂ ad.	South America.	Lafr. Coll., No.	581.
1587, ♀ “	“	“ “ “	582.
1588, ♀ “	“	“ “ “	583.

Geranospiza cærulescens (Vieill.)

1584, ♂ ad.	South America.	Lafr. Coll., No.	579.
1585, ♂ “	“	“ “ “	580.

(Group *Urubitingæ.*)

Urubitinga zonura (Shaw). (77.)

1543, ♂ ad.	Brazil.	Lafr. Coll., No.	538.
1544, ♂ “	“	“ “ “	539.
1545, — “	“	“ “ “	540.
1546, ♀ “	“	“ “ “	541.
—— — juv.	Guatemala.	Van Patten.	

Urubitinga anthracina (Nitzsch). (78.)

1548, ♂ ad.	Tropical America.	Lafr. Coll., No. 543.	(Labelled as from "Africa"!)
1549, ♀ ad.	Tropical America.	Lafr. Coll., No. 544.	(Labelled as from "Africa"!)
1550, ♀ juv.	Tropical America.	Lafr. Coll., No. 545.	(Labelled as from "Africa"!)
9535, — ad.	Tropical America.	Lafr. Coll., No. 459.	
e 62, — "	Belize, Honduras.	Wood.	

Urubitinga (Buteogallus) æquinoctialis (Gmel.). (74.)

1345, ad.	Cayenne.	Lafr. Coll., No. 342.
1346, juv.	South America.	" " " 343.
1347, "	"	" " " 344.

Urubitinga (Spizigeranus) meridionalis (Lath.). (76.)

1540, ♂ ad.	South America.	Lafr. Coll., No. 535.
1541, — —	"	" " " 536.
1542, ♀ juv.	"	" " " 537.

Urubitinga (Antenor[1]) unicincta (Temm.).

a. var. *unicinctus* Temm. (55.)

1551, — ad.	South Africa.	Lafr. Coll., No. 546.
1552, — "	"	" " " 547.
—— — "	"	A. Vattemare.
—— — "	"	J. N. Reynolds.

(Group *Buteones.*)

Buteo (Leucopternis) melanops (Lath.). (66.)

1377, ♂ ad. Guiana. Lafr. Coll., No. 373.

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[1] **Antenor** Ridgway. *Nov. subgen.*

CH. Intermediate between *Buteo* and *Urubitinga*, having the long wings, robust feet and claws of former, and the elongated legs, and bill of the latter. Inner webs of outer five primaries emarginated, as in *Buteo*, in which, however, never more than four are cut. Lores naked. Type *Falco unicincta* Temm.

The name "*Craxirer* Gould," cannot be used for this species, since its type was *Buteo galopagœnsis* Gould, a bird strictly congeneric with *B. borealis*.

Buteo (Leucopternis) kuhlii Bonap. (66.)

1378, South America. Lafr. Coll., No. 374.

Buteo (Leucopternis) albicollis Cuv. (68.)

1374, ♀ ad. South America. Lafr. Coll., No. 370.
9528, — " " " " " 8449.

Buteo (Leucopternis) scotopterus Max. (69.)

1375, — ad. South America. Lafr. Coll., No. 371.
1376, — " " " " " 372.

Buteo (Asturina) nitida (Lath.)

a. var. *nitida* Lath. (281.)

1365, ♂ ad. South America. Lafr. Coll., No. 361. (Labelled from "Mexico.")
1368, ♂ ad. Brazil. Lafr. Coll., No. 364.
1369, — juv. " " " " 365.
1370, — " " " " " 366.

b. var. *plagiata* Licht. (282.)

1366, ♀ ad. Mexico. Lafr. Coll., No. 362.
1367, — — " " " " 363.
—— — — " ? Dr. S. Cabot.
—— ♂ ad. Tehuantepec. F. Sumichrast.
—— — " Costa Rica. Smithsonian Institution.

Kaupifalco monogrammicus (Temm.) (352.)

1358, — ad. Cape of Good Hope. Lafr. Coll., No. 354.
1359, — " " " " " " 355.
1360, — " " " " " " 356.

Poliornis poliogenys (Temm.) (139.)

1351, ad. Japan. Lafr. Coll., No. 348.
—— " No label.

Poliornis liventer (Temm.) (140.)

1354, ad. India. Lafr. Coll., No. 351.

Poliornis teesa (Frankl.). (137.)

1355, ad. Bengal. Lafr. Coll., No. 352.
1356, " " ? " " " 352 *bis.*

Poliornis rufipennis (Strickl.). (141.)

1357, ad. India? Lafr. Coll., No. 353.

Buteo (Rupornis) magnirostris (Gmel.)

a. var. *magnirostris* Gmel. (286.)

1361, — ad. "Brazil." Lafr. Coll., No. 357.
—— — — ——— Dr. F. W. Cragin.
—— — — ——— " "

b. var. *nattereri* Pelz.

1362, — ad. Brazil. Lafr. Coll., No. 358.
1364, — juv. " " " " 360.
—— — " " Smithsonian Institution. (No. 13848).

c. var. *griseocauda* Ridgway. (See Appendix.)

1557, ♂ ad. Rio Seco, Mexico. Jan., 1866. Dr. Bryant.
—— ♂ juv. Tehuantepec. Sumichrast.

d. var. *ruficauda* Scl. & Salv.

—— ad. Costa Rica. Smithsonian Institution. (No. 33509).

e. var. *pucherani* Verr. (288.)

1363, — ad. "Brazil." Lafr. Coll., No. 359.
9524, — " ——— " " " 8448.

Buteo (Rupornis) leucorrhous (Quoy & G.). (283.)

—— ad. South America. Smithsonian Institution. (No. 13846.)
—— " " " Lafr. Coll., No. 367.

Buteo pennsylvanicus (Wils.). (54.)

—— ad. Locality unknown. Lafr. Coll., No. 349.
—— " " " " " " 350.
27, " " "
271, juv. " "

—— ♀ juv. Cuba. Smithsonian Institution. (No. 23548.)
—— — " Costa Rica. " " (No. 33511.)
—— ♂ " Wisconsin, Sept. 9. T. Kumlein.
—— ♀ " " " 21. "

Buteo lineatus (Gmel.).

a. var. *lineatus* Gmel. (53.)

—— ♂ ad. ———
1341, ♂ ? ad. North America. Lafr. Coll., No. 339.
1340, — juv. " " " " 338.
1339, — " Savanna, Georgia. " " " 357.
—— — " Locality and donor unknown.
—— ♀ " " " " "
—— — " Wisconsin. T. Kumlein.
—— — ad. Massachusetts. Dr. Binney.

Buteo borealis.

a. var. *borealis* Gmel. (46, excl. syn.)

—— ♀ ad. Massachusetts. Dr. S. Cabot.
23, — " " Dr. Clapp.
—— ♀ juv. New Hampshire. J. G. Loring.
—— — " New England.
1337, ♀ ad. North America. Lafr. Coll., No. 335.
—— ♀ juv. No label.
—— ♂ ad. "
—— ♂ " Wisconsin. T. Kumlein.

b. var. *calurus* Cass. (48 et 49.)

1336, ♀ ad. North America. Lafr. Coll., No 334.
1338, — juv. "
24, — " Sonoma Co., California.
—— ♂ ad. No label.
—— ♂ " Nevada. Smithsonian Institution. (No. 53221.)
—— ♀ " " " " (No. 53213. *Melanistic.*)

Buteo augur Rüpp. (43.)

1325, ad. Abyssinia. Lafr. Coll., No. 324.
1326, " " " " " 325.

Buteo jackal (Daud.). (44.)

1327, ♂ ad. Africa. Lafr. Coll., No. 325.
1328, ♀ " " " " " 326.
1329, — juv. " " " " 327.

Buteo ferox (Gmel.). (42.)

1332, juv. Himalaya. Lafr. Coll., No. 330.
1333, — " " " " 331.
1334, — " " " " 332.
1335, — " " " " 333.

Buteo brachypterus Pelz. (41.)

1330, — South Africa. Lafr. Coll., No. 328.
1331, — " " " " 329.

Buteo vulgaris Bechst. (36.)

1321, ♂ ad. Europe. Lafr. Coll., No. 319.
1322, ♀ " " " " " 320.
1323, — juv. " " " " 321.
1324, — " " " " " 322.
564, — " " Dr. S. Cabot. (Labelled "*A. palumbarius*, juv.")

Buteo swainsoni Bonap. (50.)

—— ♀ juv. Ft. Saunders, Wyoming Ter. Smithsonian Institution. (No. 54324.)

Buteo erythronotus (King). (61.)

1342, ♀ ad. Straits of Magellan. Lafr. Coll., No. 340.
1343, — juv. South America. " " " 341. (=*B. varius* Gould.)
1344, ♂ ad. South America. Lafr. Coll., No. 341*bis*. (Labelled "*B. pterocles*.")

Buteo brachyurus Vieill. (284.)

1372, ♂ ad. Brazil. Lafr. Coll., No. 368.
1373, ♀ " " " " " 369.

Geranoaëtus melanoleucus (Vieill.). (152.)

1300, ♀ ad. Chile. Lafr. Coll., No. 298.
1301, ♀ juv. Brazil. " " " 299.
1302, — — " ? " " " 300.
1547, ♀ juv. " " " " 542. (Labelled "*Morphnus urubitinga.*")
—— ♀ ad. South America. A. Vattemare.
—— ♀ juv. " " " "

(Group *Haliaëti.*)

Haliaëtus leucocephalus (Linn.). (145.)

—— ♂ ad. Quincy, Massachusetts. N. B. Furnald.
430, ♀ " Locality unknown. Dr. Binney.
—— ♂ " Bangor, Maine. (*Type of Audubon's figure !*)

Haliaëtus albicilla (Linn.). (144.)

1286, ad. Europe. Lafr. Coll., No. 284.
1287, juv. " " " " 285.

Haliaëtus leucogaster (Gmel.). (149.)

1291, ♂ — Africa. Lafr. Coll., No. 289.
1292, ♀ — " " " " 290.
1293, — juv. " " " " 291.
1294, ♂ " " " " " 292.

Haliaëtus vocifer (Daud.). (150.)

1288, ♂ ad. Africa. Lafr. Coll., No. 286.
1289, ♀ " " " " " 287.
1290, ♀ juv. Abyssinia. " " " 288.

Haliaëtus (Polioaëtus) icthyaëtus (Horsf.). (134.)

1308, ♂ ad. Java. Lafr. Coll., No. 306.
1309, ♀ " " " " " 307.

Heliastur sphenurus (Vieill.). (157.)

1299, ♀ juv. Australia. Lafr. Coll., No. 297.

Heliastur leucosternus (Gould). (156.)

1298,	—	———	Lafr. Coll., No. 296.

Heliastur indus (Bodd). (155.)

1295,	— ad.	India.	Lafr. Coll., No. 293.
1296,	♀ “	“	“ “ “ 294.
1297,	— juv.	“	“ “ “ 295.
——	— ad.	Malacca.	Smithsonian Institution. (No. 13913.)
——	♀ “	Locality unknown.	Jos. Coolidge.

Milvus regalis Roux. (243.)

1379,	♀ ad.	Europe.	Lafr. Coll., No. 375.
——	♀ “	“	Dr. Bumstead.

Milvus govinda Sykes. (244.)

1380,	♀ ad.	Japan.	Lafr. Coll., No. 376.

Milvus migrans Bodd. (245.)

1385,	—	Egypt.	Lafr. Coll., No. 381.

Milvus affinis Gould. (246.)

1381,	ad.	Australia.	Lafr. Coll., No. 377.
1382,	juv.	“	“ “ “ 378.
1383,	“	“	“ “ “ 379.
1384,	“	“	“ “ “ 380.

Milvus ægyptius (Gmel.). (247.)

1386,	—	———	Lafr. Coll., No. 382.
1387,	—	———	“ “ “ 383.

Milvus isurus Gould. (248.)

1388,	ad.	Australia.	Lafr. Coll., No. 384.

Ichthyoborus nigricollis (Lath.). (75.)

1348,	— ad.	South America.	Lafr. Coll., No. 345.
1349,	— “	“ “	“ “ “ 346.
1350,	— juv.	Brazil. “	“ “ “ 347.
——	— “	“ ?	J. K. Reynolds.

(Group *Aquilæ.*)

Aquila chrysætus.

a. var. *chrysætus* Linn. (87.)

1266, ♂ ad.	Europe.	Lafr. Coll., No. 264.
1267, ♀ "	"	" " " 265.

b. var. *canadensis* Linn. (*sub* 87.)

39, ♂ juv.	Lexington, Massachusetts.	Dr. S. Kneeland.
—— ♀ ad.	No label.	

Aquila nævioides Cuv. (89.)

1268, juv.	Cape of Good Hope.	Lafr. Coll., No. 266.
1269, "	Australia.	" " " 267.
1270, —	———	" " " 268.

Aquila nævia (Gmel.). (92.)

1271, —	Asia.	Lafr. Coll., No. 269.
1272, —	" ?	" " " 270.
1273, —	——	" " " 271.
1274, juv.	Asia.	" " " 272.
1275, —	——	" " " 273.
1276, —	Australia.	" " " 274.
1277, juv.	"	" " " 275.

Aquila audax (Lath.). (95.)

1278, ad.	Australia.	Lafr. Coll., No. 276.
1279, juv.	"	" " " 277.
1280, "	"	" " " 278.

Aquila vulturina (Daud.). (98.)

1281, ♀ ad.	Africa.	Lafr. Coll., No. 279.	("*A. verreauxi.*")
1282, ♀ juv.	"	" " " 280.	"

Aquila bonelli (Temm.). (99.)

1283, ♀ —	Europe.	Lafr. Coll., No. 281.
1284, ♀ juv.	"	" " " 282.

Aquila pennata (Gmel.). (100.)

1526, ♀. Java. Lafr. Coll., No. 522.

Spizaëtus ornatus (Daud.). (102.)

1522, ♀ juv.	Brazil.	Lafr. Coll., No.	518.
1523, ♂ "	"	" " "	519.
1524, ♂ ad.	"	" " "	520.
9534, "	"	" " "	8458.

Spizaëtus tyrannus (Max.). (103.)

1518, ♂ ad.	Brazil.	Lafr. Coll., No.	514.
1519, ♀ "	" ?	" " "	515.
1520, ♂ juv.	South America.	" " "	516.
1521, ♀ "	"	" " "	517.
—— ♀ "	"	Dr. W. Cragin.	

Spizaëtus occipitalis (Daud.). (106.)

1517, ad. South Africa. Lafr. Coll., No. 513.

Spizaëtus cirrhatus (Gmel.). (111.)

1527, ♂ juv.	India.	Lafr. Coll., No.	523.	("*cristatellus* Temm.")
1528, — —	" ?	" " "	524.	" "
1529, ♀ juv.	"	" " "	525.	" "
1530, ♂ "	"	" " "	526.	
1531, ♂ "	"	" " "	527.	
? 1532, (*black*)	" ?	" " "	527 *bis*.	

Spizaëtus nipalensis (Hodgs.). (112.)

1525, ♀. India. Lafr. Coll., No. 521. ("*pulcher* Hodgs., Lafr. type.")

Spizaëtus (Spizastur) melanoleucus (Vieill.). (105.)

1533, —	South America.	Lafr. Coll., No.	528.
1534, ad.	Guiana.	" " "	529.

Morphnus guianensis (Daud.). (143.)

1538, ♀ juv.	Guiana.	Lafr. Coll., No.	533.
1539, ♂ "	"	" " "	534.
—— ♂ ad.	" ?	Dr. W. Cragin.	

Morphnus (Thrasaëtus) harpyia (Linn.). (142.)

1535, ♂ ad. South America. Lafr. Coll., No. 530.
1536, ♀ " " " " " 531.

Harpyhaliaëtus coronatus (Vieill.). (125.)

1537, — South America. Lafr. Coll., No. 532.

(Group *Circaëti.*)

Spilornis bacha (Daud.). (126.)

1312, — Java. Lafr. Coll., No. 310.
1313, — " " " " 311.
1314, — " ? " " " 312.

Spilornis cheela (Lath.). (127.)

1315, ♀ juv. India. Lafr. Coll., No. 313.

Spilornis holospilus (Vig.). (128.)

1316, ♂ ad. Manilla. Lafr. Coll., No. 314.

Circaëtus gallicus (Gmel.). (119.)

1310, —— France. Lafr. Coll., No. 308.
—— ♀ ad. Europe. " " ?

Circaëtus thoracicus (Cuv.). (120.)

1311, —— Abyssinia. Lafr. Coll., No. 309.

Helotarsus ecaudatus (Daud.). (153.)

1285, ♂ ad. Cape of Good Hope. Lafr. Coll., No. 283.

(Group *Archibuteones.*)

Archibuteo lagopus.

a. var. *lagopus* Gmel. (81.)

1319, ♂ juv. Europe. Lafr. Coll., No. 317.
1320, ♀ ad. " " " " 318.

b. var. *sanctijohannis* Gmel. (82.)

31, — ad. Locality unknown. W. Sohier. (*Melanistic.*)
—— — juv. No label.

APPENDIX.

REVISION OF THE FALCONINE GENERA, MICRASTUR, GERANOSPIZA AND RUPORNIS, AND THE STRIGINE GENUS, GLAUCIDIUM.

Based upon specimens in the Museum of the Smithsonian Institution, the Philadelphia Academy of Natural Sciences, the American Museum, at New York, the Boston Society of Natural History, the Museum of Comparative Zoology, at Cambridge, and the Ornithological Cabinet of Mr. Geo. N. Lawrence.

Genus MICRASTUR Gray.

Brachypterus Lesson, 1837 (nec Kugel, 1794!). Type *Falco brachypterus* Temm.

Micrastur G. R. Gray, 1841. Same type.

Carnifex Less., 1842 (nec Sundevall, 1836!).

Climacocercus Cabanis, 1844.

Climacourus Bonap., 1849.

Rhyncomegus Bonap., 1853.

CH. Form of *Nisus*, *i. e.*, wings short, rounded and concave, tail very long, tarsi and middle toe long and slender, and cere ascending. A distinct ruff around the face, as in *Circus*; inner webs of the primaries with their edges soft and woolly, as in the *Strigidæ*. Bill much compressed, nearly twice as deep as broad at the base, the culmen abruptly curved; commissure slightly lobed; end of lower mandible with a rounded terminal outline when viewed laterally, but in front divided by an angular notch; gonys strongly convex. Cere rather densely haired, the hairs on top recurved; nostril broadly oval, or nearly circular, against the anterior edge of the cere. Orbital region and superciliary shield perfectly bare, the latter very prominent, and exposed for its whole length, as in *Falco*. Tarsus more than twice as long as the middle toe, scarcely feathered below the knee; its scutellæ of a hexagonal form, and arranged in longitudinal series; they are larger in front and behind than laterally, and sometimes form a continuous frontal and posterior series of rather quadrate plates; top of toes with transverse scutellæ to the base; web between base of outer and middle toes well-developed; claws of normal form, well curved, and exceedingly sharp. Wing short, very rounded, and very concave beneath, the primaries much bowed; third to sixth (usually the fifth) quills longest; first very much the shortest; five outer quills with their inner webs cut (rather deeply sinuated). Tail equal to, or longer than, wing, much rounded, or graduated.

The relationship of this well-characterized, and very remarkable, genus, is nearest to *Herpetotheres*,[1] with which it agrees in osteological structure, besides in essential external features; but it differs from this in some minor points in the external anatomy, and more markedly in the nasal bones, which in the present genus are less completely ossified than in *Herpetotheres.* It presents analogies with *Circus* and the *Strigidæ* in the facial ruff, with the *Strigidæ* in the character of the inner web of the quills, as well as in the dimorphic plumage of some of the species, and with *Nisus* in its general form and habits.

Eight species are given in Gray's Hand List (I, p. 31), but of this number only five are tenable. The *M. castanilius* (No. 295) is a *Nisus* (see Sclater and Salvin, Exotic Ornithology, pl. 18). *M. ruficollis* Vieill. (No. 292), with *xanthothorax* Temm., as a synonym, *M. guerilla* Cass. (No. 296) and *M. zonothorax* Caban. (No. 297) are names for different phases of a single species; while No. 294 should stand as *concentricus* Vieill., the name *gilvicollis* Vieill. being a synonym of *M. ruficollis.*

The following synopses include all the valid species of the genus known at the present time; the first giving the prime specific characters, the second giving the sets of characters which distinguish the species.

The number of tail-bands cannot be relied on as a specific character, since there is a great variation in this respect among different individuals of the same species. Thus, *semitorquatus* has in some specimens only four bands, and in others as many as seven; *ruficollis* has four to six; *leucauchen* has six to seven, and *concentricus* three to four. The number is greater in the young plumage than in the adult.

A. — Inner toe appreciably shorter than the outer.
  a. Wing, 9.00 or more.
    1. Black above, with a nuchal collar. Tail longer than the wing, ... *M. semitorquatus.*
    2. Plumbeous above, without a nuchal collar. Tail shorter than the wing, ... *M. mirandollei.*
  b. Wing less than 8.00.
    3. Throat and adjoining portions ashy in the adult; no nuchal collar, ... *M. ruficollis.*
    4. Throat and cresent behind the jaw, white, sharply defined; a nuchal collar of whitish spots, *M. leucauchen.*

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[1] *Physta* Vieill., 1816? *Herpetotheres* Vieillot, 1818. *Cachinna* Fleming, 1822. *Macagua* Lesson, 1831. Type *Falco cachinnans* Linn.

B. — Inner toe appreciably longer than the outer.

5. Wing less than 8.00. Tail shorter than the wing. Lower tail coverts immaculate white. *M. concentricus.*

SYNOPSIS OF THE SPECIES OF MICRASTUR.

A. — Inner toe appreciably shorter than the outer. Tail longer than the wing (except in *M. mirandollei*).

a. Wing 9.00 or more; only four outer primaries with inner webs appreciably sinuated (constant?).

1. M. SEMITORQUATUS. Wing, 9.70–11.20; tail, 9.80–13.00. Above plumbeous-black, or blackish brown, interrupted by a nuchal collar of white or ochraceous. *Adult.* Lower parts immaculate white or ochraceous. *Young.* Lower parts barred, or transversely spotted, with blackish. *Hab.* Whole of Continental Tropical America.

2. M. MIRANDOLLEI. Wing, 9.00–9.30; tail, 7.80–9.00. Above uniform slaty plumbeous, without a lighter nuchal collar. Lower parts white, the breast sometimes with faint crescentic marks of grayish. *Young* not seen. *Hab.* Brazil to Panama.

b. Wing less than 8.00, five outer primaries with inner webs appreciably sinuated.

3. M. RUFICOLLIS. Wing, 6.30–7.30; tail, 7.00–8.00; tarsus, 2.20–2.35. Adult without a light nuchal collar; crissum transversely barred. *Adult.* Above varying from slate-color to reddish sepia; head and neck uniform grayish, the throat lighter; breast usually more or less rufescent. Beneath white, everywhere with regular, continuous, narrow bars of dusky slate. *Young.* Above dark sepia; pileum darker, and separated by a nearly concealed whitish nuchal collar. Beneath, including the throat, pale ochraceous, or ochraceous-white, the breast, sides and tibiæ with narrow transverse bars of dusky brown, varying with the individual in number and distinctness. *Hab.* Whole of Continental Tropical America.

4. M. LEUCAUCHEN. Wing, 6.20–6.60; tail, 7.20–7.50; tarsus, 2.00–2.10. Adult with a nuchal collar of white spots; crissum transversely barred. Chin, throat,

and crescent curving upward behind the auriculars, pure white. *Adult.* Above umber- or sepia-brown, the top of the head usually darker. Beneath white, sometimes tinged with ochraceous, the breast more or less washed with rufous, the whole surface, except the throat and anal region, narrowly barred transversely with blackish, the bars fainter in the reddish of the breast. *Young* not seen. *Hab.* Brazil.

B. — Inner toe appreciably longer than the outer. Tail shorter than the wing.

c. Wing less than 8.00; five outer primaries with inner webs appreciably sinuated.

5. M. CONCENTRICUS. Wing, 7.10–7.55, tail, 6.30–6.50; tarsus, 2.25–2.45. *Adult.* Above uniform plumbeous-ashy, sometimes more bluish anteriorly, and without a lighter nuchal collar. Beneath white, the crissum and anal region immaculate; other portions transversely barred with slate-color. Head plain ashy, the throat paler, and the pileum darker. *Young* not seen. *Hab.* Whole of Continental Tropical America.

1. **Micrastur semitorquatus** (Vieillot).

Sparvius semitorquatus Vieill., Nouv. Dict. x, 1818, 322. — *Id.* Enc. Méth. III, 1263.

Micrastur semitorquatus Scl. and Salv., Ibis, 1839, 218.— *Id.* P. Z. S. 1869, 365. — Strickl., Orn. Syn. I, 1855, 122.— Lawr., Ann. N. Y. Lyc. IX, 134.

Sparvius melanoleucus Vieill., N. D. x, 1817, 327. — *Id.* Enc. Méth., 1267.

Falco brachypterus Temm., Pl. Col. 116 (*juv.*) et 141 (*ad.*).

Astur brachypterus Spix., Av. Bras. I, 9.— Vig., Zool. J., I, 338.— Steph., Zool. XIII, pt. 2, 28.

Nisus brachypterus Less., Man. Orn. I, 98.— *Id.* Tr. Orn., 62. — Cuv., Règ. An., ed. 2, I, 334.— Schleg., Mus. Pays-Bas, *Astures*, p. 52.

Accipiter brachypterus Gray, List B., Brit. Mus., 69.

Micrastur brachypterus Gray, Gen. B., ed. 2, p. 6; fol., sp. 1, pl. 10, f. 1. — *Id.* Hand List, I, 31, No. 290. — Pelzeln, Orn. Bras. IV, 398.

Herpetotheres brachypterus Kaup, Monog. Falc. in Contr. Orn. 1850, 71.

Falco leucomelus (Illig.) Licht., Verz. Doubl., p. 62; 1823.
Carnifex naso Less., L'Echo du Monde savant, année 9, p. 1081.— *Id.* Rev. Zool. 1842, 379.

Sp. ch. Wing, 9.70–11.20; tail, 9.80–13.00; culmen, .80–1.00; tarsus, 3.10–3.40; middle toe, 1.60–2.05. 3d–6th quill longest; 1st much the shortest. Above plumbeous, black to blackish brown, interrupted by a more or less conspicuous nuchal collar of white or ochraceous. Tail with 4–7 narrow light bands, usually interrupted, the last terminal, the first concealed. *Adult.* Lower parts entirely immaculate, varying from pure white to deep ochraceous. Upper parts unvariegated; nuchal collar distinct. *Young.* Lower parts more or less barred or spotted with blackish; upper parts usually more or less obscurely barred, or spotted transversely, with ochraceous, or dull rusty.[1]

Specimens examined. Nat. Mus., 15; Philad. Acad., 7; Boston Soc., 2; Cab. G. N. Lawrence, 3. Total, 27.

Hab. Whole of Continental Tropical America from Mazatlan and Vera Cruz to Southern Brazil.

2. **Micrastur mirandollei** (Schlegel).

Astur mirandollei Schleg., Ned. Tijdschr, I, 130; — *Id.* Mus. Pays-Bas, *Astures*, p. 27.
Micrastur mirandollei Scl. & Salv., P. Z. S. 1867, 759.— *Id.* P. Z. S. 1869, 365. — Gray, Hand List, I, 31, no. 291. — Pelz., Orn. Bras, IV, 398.
Micrastur macrorhynchus (Natt.) Pelz., Orn. Novara, 1865, p. 11.— *Id.* Orn. Bras., p. 7.

Sp. ch. Wing, 9.00–9.30; tail, 7.80–9.00; culmen, .80–.85; tarsus, 2.80–3.15; middle toe, 1.30–1.45. 5th quill longest; 1st shortest. *Adult.* Above uniform plumbeous, without a lighter nuchal collar; tail more blackish, narrowly tipped with white, and crossed by three narrow bands of white, transversely mottled with dusky, or pale grayish brown, the first concealed by the coverts. Lower parts, including the under side of the wing, and sometimes the maxillæ, continuous white, the shafts of some of the feathers usually black; breast sometimes with faint crescentic transverse spots of pale grayish.

Specimens examined. Philad. Acad., 2; Cab. G. N. Lawrence, 2; Boston Society, 1. Total, 5.

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[1] All specimens seen from Tehuantepec and Mazatlan are pure white beneath, and those from Gautemala, Costa Rica and Panama deep ochraceous.

Hab. Northern South America, Eastern Peru (Sclater and Salvin); Brazil (Mus. Philad. Acad. and Boston Soc.); Rio Negro and Rio Brancho (Scl. and Salv.); Panama (Cab. G. N. Lawrence).

3. **Micrastur ruficollis** (Vieillot).

Sparvius ruficollis Vieill., N. D., x, 322, 1817 (*rufescent phase*). — *Id.* Enc. Méth. III, 1263. — Pucher., R. Zoöl. 1850, 91.

Micrastur ruficollis Strickl., Orn. Syn., I, 1855, 122. — Scl. and Salv. P. Z. S., 1869, 366. — Gray, Hand List, I, 31, no. 292.

Sparvius gilvicollis Vieill., Nouv. Dict. x, 1817, 323 (*grayish phase.*) — *Id.* Enc. Méth. III, 1264. — Pucher., Rev. Zool. 1850, 91.

Micrastur gilvicollis Pelz., Orn. Nov. 1865, 10 (Diagnosis, corrected synonomy, and remarks). — *Id.* Orn. Bras., 399.

Falco xanthothorax Spix., Av. Bras. I, 1824, 19 (*rufescent phase*). — Temm., Pl. Col., 92.

Astur xanthothorax Vig., Zool. J. I, 338. — Steph., Zool. XIII, pt. 2, 27.

Nisus xanthothorax Less., Man. Orn. I, 96. — *Id.* Tr. Orn., 58. — Cuv., Rég. An., ed. 2, 334.

Accipiter xanthothorax Gray, List B. Brit. Mus., 69. — Cass., P. A. N. S. 1848, 88.

Micrastur xanthothorax Gray, Gen. B. fol., sp. 2. — Bonap., Consp. I, 30. — Pelz., Orn. Bras., 399.

Herpetotheres xanthothorax Kaup, Monog. Falc. in Contr. Orn. 1850, 71. — Pelz., Orn. Nov. 1850, 12.

Falco trifasciatus Natterer, Cat. Msc., no. 954. (Pelzeln).

Climacocercus concentricus, juv. Cabanis, Tschudi, Fauna Per., 99 (not *Falco concentricus* of Illiger!).

Falco concentricus Puch., Rev. Zool. 1850, 91, (not *F. concentricus* of Illiger!).

Micrastur guerilla Cass., P. A. N. S. Philad. 1848, 87 (*young plumage*). — Gray, Gen. B., fol., sp. 4. — *Id.* Hand List, I, 31, no. 296. — Bonap., Consp. I, 30. — Pelz., Orn. Nov. 1850, 12. — Scl. and Salv., P. Z. S. 1869, 367.

Climacocercus zonothorax Cab., Journ für Orn. 1865, 406.

Micrastur zonothorax Scl. and Salv., P. Z. S. 1869, 253, and 366. — Gray, Hand List, I, 31, no. 297.

Micrastur leucauchen Scl. and Salv., P. Z. S. 1869, 367 (excl. synonomy).

Sp. ch. Wing, 6.30–7.30; tail, 7.00–8.00; culmen, .50–65; tarsus, 2.20–2.35; middle toe, 1.10–1.25; graduation of tail, 1.50–2.00. (Extremes of 37 specimens.) Adult without any nuchal collar and with the lower tail-coverts barred. *Adult.* [*a. Normal plumage.*] Above slate-color, sometimes more or less tinged with sepia, occasionally quite rufescent on the wings. Tail darker, with 4–6 narrow, interrupted bars of white. Head and neck, (all round), uniform ashy, darker on the pileum, paler on the throat. Lower parts, and lining of the wing, white, the whole surface about equally barred with dark slate; pectoral region often more or less tinged with rufous. (=*gilvicollis* Vieill., and *zonothorax* Cabanus). [*b. Rufescent plumage.*] Above sepia-brown, with a rufescent cast, the pileum more grayish; tail darker, with 4–6 narrow bars of whitish; head, neck and breast continuous brownish, the tint rufous on the breast, more grayish on the pileum, and whitish on the throat. Lower parts white, with regular transverse bars of dusky, about equal to the white ones in width; crissum and lining of the wing similarly barred. (= *ruficollis* Vieill, and *xanthothorax* Spix.) *Young.* Head, superiorly and laterally, brownish black, the auriculars more brownish; rest of the upper parts dark sepia-brownish, separated from the blackish of the head by a narrow, sometimes nearly concealed, nuchal collar of whitish; longer scapulars and inner secondaries sometimes showing obscure bars of lighter brownish, on either web. Tail as in the adult. Beneath, pale ochraceous, or ochraceous-white, the throat and anal-region purer white; breast, sides, and tibiæ with more or less numerous narrow transverse bars of dusky brown, much more distant, sparse, and irregular than in the adult. (= *guerilla* Cassin.)

Specimens examined. Nat. Mus., 11; Philad. Acad., 9; N. Y. Mus., 1; Boston Soc., 9; Mus. Cambridge, 2; Cab. G. N. L., 5. Total, 37.

Hab. Whole of Continental Tropical America, from eastern Mexico (Jalapa) to southeastern Brazil and western Ecuador. The following localities represented by the specimens examined: — Guatemala, Costa Rica, Jalapa, Mexico, Guyaquil, Panama and Brazil.

There can be no doubt that the rufescent plumage described above, and identified as *ruficollis* of Vieillot and *xanthothorax* of Spix, is a phase of the same species as the grayish plumage to which the names *gilvicollis* Vieillot and *zonothorax* Cabanis belong, as they are connected by a gradual transition in intermediate specimens contained in a large series. This is the sole instance, to our knowledge, among the *Falconidæ* of a kind of dimorphism analogous to that seen in some owls, (as species of *Scops* and *Glaucidium*, *Syrnium aluco*, *etc*). The amount of the rufous wash varies almost with the individual, so that it is impossible to separate specifically the two styles. In the young plumage (*M. guerilla* Cassin), the difference in the two phases is not so great as in the adult dress; but those of the rufescent style have a more or less appreciable wash of rusty across the jugulum. One specimen has the upper parts variegated by somewhat concealed transverse spots of whitish.

The *M. ruficollis*, *M. zonothorax*, *M. guerilla*, and, apparently, also the *M. leucauchen* of Sclater and Salvin's paper in the Proceedings of the Zoölogical Society of London, 1869, (pp. 364–369) belong to this species.

4. **Micrastur leucauchen** (Temminck).

Falco leucauchen Temm., Pl. Col. 36; 1823. — Pucher., Rev. Zool. 1852, 91.

Astur leucauchen Less., Man. Orn. I, 92.— *Id.* Tr. Orn., 60.— Cuv., Règ. An. ed. 2, 332.

Nisus leucauchen Less., Tr. Orn., 60.

Accipiter leucauchen Gray, List B. Brit. Mus., 68.—Cass., P. A. N. S. 1848, 88.

Micrastur leucauchen Bonap., Consp. I, 30. — Strickl., Orn. Syn. I, 123.

Sp. ch. Wing, 6.20–6.60; tail, 7.20–7.50; culmen, .50–.55; tarsus, 2.00–2.10; middle toe, 1.00–1.10. Graduation of the tail, about 2.00. Chin, throat, and crescent extending upward behind the auriculars, along the lower half of the "ruff," immaculate white, quite abruptly defined. *Adult.* Above umber-brown, sometimes tinged with sepia, interrupted by a nuchal collar of partly concealed white spots; top of the head usually darker. Tail darker, with 6–7 narrow interrupted bands of transverse white spots. Beneath white, sometimes tinged with ochraceous, the breast more or less washed with rufous; the whole surface, except the throat and anal region, narrowly barred transversely with blackish, the bars fainter in the reddish of the breast.

Specimens examined. Philad. Acad., 4.

Hab. Brazil.

The *M. leucauchen* of Sclater and Salvin (see above) is apparently not this species, which is well figured in Temminck's plate, above cited, but is to be referred rather to the gray phase of *M. ruficollis.*

5. Micrastur concentricus (Illiger).

Falco concentricus Illig. in Mus. Berol.

Nisus concentricus Lesson, Tr. d'Orn.

Climacocercus concentricus Caban., in Erich. Archiv. 1844, I, 265. — *Id.* Tschudi, Fauna Per. 18 and 98.—*Id.* Schomb., Reise Guiana, III, 735.— Burm., Thiere Bras. II, 86.

Circaëtus (Herpetotheres) concentricus Kaup, Isis, 1847, 260.— *Id.* in Trosch. Arch. 1850, I, 37.

Micrastur concentricus Gray, Gen. 28, (excl. syn. Vieill.). — Bonap., Consp. I, 30 (excl. syn. Vieill.). — *Id.* Rev. Zool. 1854, 537. — Strickl., Orn. Syn. I, 123 (in part). — Pelzeln, Orn. Nov. 1865, 1865, 9 (diagnosis, corrected synonomy and remarks). — *Id.* Orn. Bras., 399.

Falco senex Natterer, in Mus. Vindob. (fide Pelzeln).

Micrastur gilvicollis Scl. and Salv., P. Z. S. 1869, 368 (excl. synonomy).

Sp. ch. Wing, 7.10–7.55; tail, 6.30–6.50; culmen, .60; tarsus, 2.25–2.45; middle toe, 1.00–1.08. *Adult.* Above uniform plumbeous-ashy, sometimes more bluish anteriorly. Tail black, with 3–4 very narrow, distant bars of white. Beneath white, the breast, sides, and abdomen barred with slate-color; tibiæ with fewer, narrower bars of the same; crissum and anal region immaculate, and lining of the wing barred only along the exterior border. Throat plain pale ashy, or ashy white, this gradually paler than the cheeks, which are lighter ash than the crown.

Specimens examined. Philad. Acad., 5; Boston Society, 1; N. Y. Mus., 1 (Amazon). Total, 7.

Hab. Whole of Continental Tropical America. Brazil, (Mus. Boston Soc.); Amazon, (N. Y. Mus.); Mexico, (Bonaparte); Bolivia, (D'Orbigny); Bahia, Guiana, Rio Negro, and Rio Janeiro, (Pelzeln).

With a general or superficial resemblance to the gray phase of *M. ruficollis* ("*gilvicollis*" and "*zonothorax*") this very distinct species may be immediately distinguished without comparison, by having the outer toe shorter than the inner, the tail shorter than the wing, and by the unbarred crissum of the adult plumage. Pelzeln is right in considering it the true *M. concentricus.*

Genus GERANOSPIZA Kaup.

Ischnoceles Strickl., 1844. Type, *Falco gracilis* Temm. (not *Ischnocelis* Burm., 1842).

Geranospiza Kaup, 1847. Same type.

Geranopus Kaup, 1851. Same type.

CH. Form very slender, the wings and tail very long, the head small, bill weak, and tarsi extremely elongated and slender. Outer toe very much shorter and weaker than the inner, and about equal in length to the posterior, its claw disproportionately small and weak. Tibio-tarsal joint flexible both backward and forward! Secondaries much developed, reaching nearly to the end of the primaries, and very broad. Bill much as in *Nisus*; nostril obliquely horizontal, oval. Tarsus about two and a half times as long as the middle toe, with frontal and posterior series of broad transverse scutellæ, these often fused into continuous plates; claws normal. Tibial feathers short and close, not plume-like. Wing long, but the primaries not much longer than the secondaries, the fourth to the sixth quills longest, the first shortest, and much bowed; outer six with inner webs sinuated. Tail long, nearly equal to the wing, rounded, the feathers very broad.

This remarkable genus is closely related to *Polyboroides* of Southern Africa, with which it agrees in certain characters which separate them from all other *Falconidæ*, and mark them as very specialized members of the buteonine group. The excessive abbreviation of the outer toe, as compared with the inner, is shared by *Heteropus* (type *H. malayensis* Reinw.) an aquiline form belonging to the East Indian region; but the singular flexibility of the tibio-tarsal joint is probably found in no other genus, unless it may possibly exist in a less exaggerated degree in *Melhierax* of Africa, or still less developed in *Urubitinga zonura* of Tropical America. Mr. Gurney speaks at length, in his "Descriptive Catalogue of the Raptorial Birds in the Norfolk and Norwich Museum" (London, 1864) of this peculiar feature in *Polyboroides*, and mentions *Geranospiza* as being nearly related in general form and other features. Through the courtesy of Professor Agassiz and Mr. Allen, of the Museum of Comparative Zoölogy, at Cambridge, I have been permitted to examine an alcoholic specimen of *G. cærulescens*, and find that the singular feature above referred to is just as well developed in *Geranospiza*, thus confirming the relationship hinted at by Mr. Gurney.

The following table will show more exactly the relationship between these two remarkable genera: —

Common Characters. Form very slender and elongated, fitted for a terrestrial life. Head small, bill weak, tarsi long and slender, and remiges and rectrices much developed, the secondaries very broad and elongated, but shorter than the longest primaries. Outer toe much shorter and weaker than the inner; tibio-tarsal joint flexible in both directions. Tarsus more than twice as long as the middle toe. Tail nearly as long as the wing, rounded. Coloration: — Ashy or blackish, the lower parts usually with white bars; tail black with white bands.

Geranospiza. Whole head normally feathered. Tarsi with a frontal and posterior series, or single row, of broad, regular, transverse scutellæ. *Hab.* Tropical America.

Polyboroides. Whole side of the head naked, including lore, lower jaw, superciliary region and temporal region. Tarsi reticulated, or covered uniformly with small longitudinally hexagonal scales. *Hab.* Southern Africa.

SYNOPSIS OF THE SPECIES OF GERANOSPIZA.

1. G. gracilis. Crissum whitish, plain, or sparsely barred. Wing, 11.00–15.25; tail, 9.75–12.50; culmen, .75–.80; tarsus, 2.95–4.30; middle toe, 1.15–1.60. Deep plumbeous above, uniform, except on the wings; lower parts, and sometimes the wing-coverts, barred transversely with white; primaries, plumbeous-black, with an obscure plumbeous spot about the middle portion. Tail, deep ochraceous, narrowly tipped with white, the terminal half crossed by two distinct bands of black — the last subterminal; the intermediæ crossed by about three bands each of black and whitish, of about equal width, the posterior light band having an ashy cast.

Hab. Paraguay and Brazil.

2. G. cærulescens. Crissum plumbeous or black, with or without bars. Wing, 10.00–13.80; tail 8.00–11.00; culmen, .68–.85; tarsus, 2.90–3.60; middle toe, 1.12–1.50. Uniform plumbeous or plumbeous-black, usually without white bars, but occasionally with faint ones on the lining of the wing, tibiæ, or other portions of the lower parts. Primaries and tail black, the latter tipped with white, and crossed by about three distinct bands of white, much narrower

than the black ones. Inner webs of primaries crossed about the middle, by a single oblique series of large quadrate spots of white.

a. Wing, 10.00–11.00; tail 8.00–8.50; culmen, .68–.80; tarsus, 2.90–3.10; middle toe, 1.12–1.35. Color, bluish plumbeous, without light bars, except on the tibiæ and lining of the wing. *Hab.* Tropical America south of Panama. . . . . var. *cœrulescens.*

b. Wing, 12.00–13.80; tail, 10.00–11.00; culmen, .80–.85; tarsus, 3.30–3.60; middle toe, 1.40–1.60. Color, plumbeous-black, the lining of the wing, tibiæ, and crissum—sometimes entire lower parts — obscurely and narrowly barred with white. *Hab.* Tropical America north of Panama. . . . . var. *niger.*

1. **Geranospiza gracilis** (Temminck).

Falco gracilis Temm., Pl. Col. 91, 1823.

Astur gracilis Vig., Zool. Journ. I, 338. — Steph., Zool. XII, pt. 2, 26. — Gray, List B. Brit. Mus. 1844, 33. — Lafr., R. Z. 1848, 242.— Kaup, Ueb. Falk. Mus. Senk., 249.

Nisus gracilis Less., Man. Orn. I, 96; Tr. Orn., 63.

Ischnocelis gracilis Strickl., Ann. N. H. XIII, 409; Orn. Syn. I, 1855, 124.

Geranospiza gracilis Gray, Gen. B. fol., sp., I; List B. Brit. Mus., 68; Hand List, I, 31, no. 289 (in part).— Bonap., Consp., 30.

Geranopus gracilis Kaup, Monog. Falc., in Contr. Orn. 1850, 65. — Pelz., Orn. Bras., 398.

Hab. Eastern South America (Paraguay and Brazil).

Specimens examined. Nat. Mus., 4; Philad. Acad., 3; N. Y. Mus., 2; Boston Society, 3. Total, 12.

2. **Geranospiza cærulescens** (Vieillot).

a. var. **cærulescens** Vieill.

Sparvius cœrulescens Vieill., Nouv. Dict. X, 318; 1817. — *Id.* Enc. Méth. III, 1262. — Pucher., R. Z. 1850, 90.

Ischnoceles cœrulescens Strickl., Orn. Syn. I, 124.

Falco hemidactylus Temm., Pl. Col. 3, 1820. — Max., Beitr. III, 97.

Astur hemidactylus Vig., Zool. Journ. I, 338. — Steph., Zool. XIII, pt. 2, 26. — Kaup, Ueb. Falk. Mus. Senk., 249.

Nisus hemidactylus Less., Man. Orn. I, 96. — *Id.* Tr. Orn., 63. — Cuv., Règ. An. ed. 2, I, 333. — D'Orb., Voy. Am. Mer., 88.— Schleg., Mus. Pays-Bas. *Astures*, p. 53 (in part).

Ischnoceles hemidactylus Gray, Gen. B. fol. pl. 10, f. 6. — Hartl., Syst. Ind. Azar., p. 2.

Geranospiza hemidactylus Bonap., Consp., 30 (sub *I. gracilis*).

Geranopus hemidactylus Pelz., Orn. Bras., 368.

Falco weidii brasiliensis Gray, Griff. Cuv., 238.

Hab. Tropical America, south of Panama. Brazil (Mus. S. I., Boston Society, Philad. Acad. and Cambridge); Isle of Puna (Strickland); Panama (Cab. G. N. Lawrence).

List of specimens. Philad. Acad., 3; Cab. G. N. Lawrence, 2 (Napo and Panama); Boston Society, 2 (Brazil); Mus., Cambridge, 1 (Brazil). Total, 8.

b. var. **niger** Dubus.

Ischnoceles niger Dubus, Bull. Ac. Roy. Brux. 1848; Esg. Orn., pl. 16. — Lafr., R. Z. 1848, 241. — Strickl., Orn. Syn. I, 125.

Geranospiza nigra Gray, Gen. B. fol., sp., 2. — Bonap., Consp., 30.

Ischnocelis aterrimus Licht., Nomencl. Mus. Berol., p. 4, 1854.

Nisus hemidactylus Schleg., Mus. Pays-Bas, *Astures*, p. 53 (in part.).

Hab. Tropical Am. north of Panama. Mazatlan (Nat. Mus.) Tehuantepec (Cab. G. N. Lawrence).

Specimens examined. Nat. Mus., 4; Cab. G. N. Lawrence, 1 (Tehuantepec). Total, 5.

Specimens from Panama are exactly intermediate between *cœrulescens* from Brazil and *niger* from Mexico.

Genus BUTEO. — Subgenus RUPORNIS Kaup.

Rupornis Kaup, 1844. Type *Falco magnirostris* Gmel.

CH. Similar to the smaller species of *Buteo*, but differing in having five, instead of only three or four, outer quills with their inner webs cut, and in the young plumage being scarcely different from the adult.

The known species of this subgenus are but two in number, the *R. magnirostris* and *R. leucorrhous* — the former with several geographical races usually recognized as species. They have usually been included in the genus *Asturina* along with the *A. nitida*. The latter, however, is quite distinct subgenerically, and more nearly related to *Leucopternis*, another subgenus of *Buteo*.

SPECIES AND RACES.

1. R. MAGNIROSTRIS. Above umber, or grayish brown, the tail with black bands, and often tinged with rufous; inner webs of sec-

ondaries and primaries with more or less of rufous. Beneath whitish, usually tinged more or less with ochraceous, the anterior parts plain brownish (in *adult*), or longitudinally striped (in *young*), the posterior portion (from the breast back) transversely barred. Wing, 8.70–10.80; tail, 6.50–8.00; culmen, .70–.80; tarsus, 2.25–2.40; middle toe, 1.20–1.40. *Hab.* Whole of Tropical America.

2. R. LEUCORRHOUS. Entirely brownish black, the tail coverts (upper and lower) and lining of the wing white, the latter with an ochraceous tinge; inner webs of primaries barred, or mottled transversely, with white. Tail faintly tipped with grayish, and crossed by 2–3 faintly indicated bars of grayish brown, passing into white on the inner webs. Inner side of tibiæ chestnut-rufous. Wing, 7.80–9.20; tail, 6.00–6.50; culmen, .65; tarsus, 2.25–2.35; middle toe, 1.25–1.30. *Hab.* Northern half of South America.

1. **Buteo (Rupornis) magnirostris** (Gmelin).

SP. CH. Wing, 8.70–10.80; tail, 6.50–8.00; culmen, .70–.80; tarsus, 2.25–2.40; middle toe, 1.20–1.40.

Fourth and fifth, or fifth, quills longest. Tail rounded. Young and adult stages scarcely different. Above, plain grayish, varying from pure ashy to umber, — the head most ashy; secondaries and primaries with more or less of bright rufous on their inner webs, this also conspicuous on the outer webs of the inner primaries, and usually narrowly and distantly barred with dusky. Upper tail coverts white, barred with brown. Tail varying from pure cinereous to deep rufous, and crossed by from three to seven bands of dusky. Beneath white from the breast back, barred transversely with brown, usually of a reddish cast. *Adult.* Anterior lower parts plain brownish (always?). *Young.* Anterior lower parts striped with dark brown upon a whitish ground. (Tail bands more numerous?)

SYNOPSIS OF THE GEOGRAPHICAL RACES.

A. — Tail grayish brown, or ashy, without any tinge of rufous.

1. Tail pure light ash, concolor with the back, the 3–4 broad black zones about equal in width to the gray ones; jugulum plain ash; lower parts pure white, broadly barred with reddish ashy. Wing, 8.50–9.50; tail, 6.50–7.00; tarsus, 2.25–2.40; middle toe, 1.20–1.30. *Hab.* Northern South America. . . . . var. *magnirostris*.

2. Tail deep, rather brownish, ash, not decidedly lighter than the back; the 3–4 black bands about equal to the gray ones; jugulum plain brown, or rufous, in the adult, longitudinally striped in the young. Lower parts yellowish white, about equally barred with dull light rufous. Wing, 8.50–9.50; tail, 6.50–7.00; culmen, .75; tarsus, 2.20–2.50; middle toe, 1.15–1.20. *Hab.* Eastern South America.
. . . . var. *nattereri.*
3. Tail ash, decidedly lighter than the back, the 5–7 black bands equal to, or scarcely narrower than, the gray ones; jugulum always variegated with whitish — transversely spotted in adult, longitudinally striped in young. Lower parts barred broadly with brown (varying from bright rufous to plumbeous-umber). Wing, 8.70–10.00; tail, 6.30–7.50; culmen, .75–.80, tarsus, 2.35–2.50. *Hab.* Southern and Middle Mexico. . . . . var. *griseocauda.*

B. — Tail rufous, or much tinged with rufous.

4. Black bands of tail nearly equal to, or only a little narrower than, the deep rufous ones; jugulum never (?) longitudinally striped, lower parts broadly barred with rufous. Wing, 8.70–10.00; tail, 6.50–7.50; culmen, .75–.80; tarsus, 2.35–2.50; middle toe, 1.15–1.30. *Hab.* Region of Isthmus of Panama (Panama to Guatemala).
. . . . var. *ruficauda.*
5. Black bands of tail much narrower than the light rufous ones; jugulum always (?) striped longitudinally; lower parts very narrowly barred. Wing, 9.40–10.70; tail, 7.00–7.75; culmen, .65–.85; tarsus, 2.40–2.60; middle toe, 1.20–1.35. *Hab.* Southern half of South America.
. . . . var. *pucherani.*

a. var. **magnirostris** Gmel.

L'èpervier à gros bec de Cayenne Buff., Pl. Enl., 464.

Falco magnirostris Gmel., S. N. I, 282.

Nisus magnirostris Tschudi, F. P., Aves, p. 104.

Rupornis magnirostris Cab., in Schomb. Guian. III, 737.

Asturina magnirostris Sclater, P. Z. S. 1857, 261; 1858, 451; 1859, 147; 1860, 288.— Scl. and Salv., P. Z. S. 1866, 198; 1867, 589, 753; 1869, 131.

Astur macrorhynchus Pelz., Orn. Bras., p. 6; IV., 463.

Falco insectivorus Spix, Av. Bras., I, 17, t. 8ª (*partim*).

Ch. Wing, 8.50–9.50; tail, 6.50–7.00; tarsus, 2.25–2.40; middle toe, 1.20–1.30. *Adult.* Tail pure light cinereous, concolor with the back, crossed with three broad zones of black (sometimes a fourth indicated) about equal in width to the ash. Head, jugulum and whole upper parts, plain pale ash; no white on the lores; rufous on the outer webs of the quills not barred with dusky, or else only indistinctly so. Lower parts pure white, more broadly barred with reddish ashy.

Hab. Northern South America, from the Atlantic to the Pacific. Cayenne, (Buffon); Brit. Guiana (Schomb.); Rio Negro, Rio Brancho and Rio Madeira (Natterer); Venezuela (Gœring); Mexiana (Wallace); E. Peru (Bartlett and Tschudi); Bogota (Mus. S. and G.); W. Ecuador (Fraser).

Specimens examined. Nat. Mus., 3; Philad. Acad., 5; Boston Soc., 3; Cab. G. N. Lawrence, 2 (Bogota.) Total, 13.

b. var. **nattereri** Sclater and Salvin.

Falco magnirostris Max., Beitr., III, 102.— Temm., Pl. Col. 86 (*juv.*). — Spix., Av. Bras. I, 18 (in part).

Astur magnirostris Pelz., Orn. Bras., p. 6; IV, 463.

Nisus magnirostris Burm., Syst. Ueb. II, 76.

Asturina nattereri Scl. and Salv., P. Z. S. 1869, 132 and 598; Ex. Orn. XI, 1869; pl. LXXXVII.

Astur nattereri Reinh., Ved. Med. 1870, 69.

Ch. Wing, 8.50–9.50; tail, 6.50–7.00; tarsus, 2.20–2.50; middle toe, 1.15–1.20; culmen, .75. Tail deep, somewhat brownish, ash, lighter than the back, crossed by three distinct, and one or two obscure, bands of black. Upper parts plain brownish slate. Rufous of the quills narrowly, but distinctly, barred with black. Lower parts about equally barred with dull, rather light, rufous and yellowish white. *Adult.* Breast nearly plain, or unvariegated; varying from dull light rufous to grayish brown. *Young.* Breast longitudinally striped with brown or rufous, on a whitish ground.

Hab. Brazil and Peru?; S. E. Brazil (Max. et Burm.); Bahia (Wucherer); San Paulo and Matogrosso (Natterer); Rio de Janeiro and Rio das Velhas (Mus. Comp. Zool.), Peru (Scl. and Salvin).

Specimens examined. Nat. Mus., 6; Philad. Acad., 1; Boston Society, 3; Mus. Cambridge, 4; N. Y. Mus., 2; Cab. G. N. Lawrence, 1. Total, 17.

c. var. **griseocauda** Ridgway.

Asturina ruficauda Scl. and Salv., P. Z. S. 1869, 133 (in part).

Asturina magnirostris Auct. (All citations from Mexico.)

Ch. Wing, 8.70–10.00; tail, 6.30–7.50; culmen, .75–80; tarsus, 2.35–2.50. Tail ashy, decidedly lighter than the back, and scarcely, or not at all, tinged with rufous; crossed by 5–7 bands of black, about equal to, or slightly narrower than, the grayish ones. Above, ashy umber, the head more plumbeous; breast plumbeous-umber, more or less variegated with white; other lower parts yellowish white, barred, usually broadly, with brownish, varying in shade from bright rufous to plumbeous-umber; tibiæ ochraceous, narrowly and faintly barred with rusty. Rufous on the outer webs of the quills sometimes wanting; when present, barred with dusky. *Adult.* Breast transversely spotted with whitish. *Young.* Breast longitudinally streaked with whitish. *Hab.* Mexico, from the Atlantic to the Pacific, from Yucatan and Mirador to Mazatlan and Colima (numerous specimens in Mus., S. I.); Rio Seco and Tehuantepec (Mus. Boston Soc.).

Specimens examined. Nat. Mus., 10; Philad. Acad., 1; Boston Society, 2; Cab. G. N. Lawrence, 1. Total, 14.

d. var. **ruficauda** Sclater and Salvin.

Asturina magnirostris Scl., P. Z. S. 1856, 285; 1859, 368; 1864, 178. — Scl. and Salv., Ibis, 1859, 217. — Lawr., Ann. N. Y. Lyc. VII, 316; VIII, 178. — Moore, P. Z. S. 1859, 52.

Asturina ruficauda Scl. and Salv., P. Z. S. 1869, 133; Ex. Orn. XI, 1869, pl. lxxxviii.

Ch. Wing, 8.70–10.00; tail, 6.50–7.50; culmen, .75–.80; tarsus, 2.35–2.50; middle toe, 1.15–130. Tail deep rufous, but usually more or less mixed with ash of a similar tint to the back; crossed by 4–5 bands of black, a little, sometimes considerably, narrower than the rufous. Upper parts, and head, uniform ash (a shade darker than in *magnirostris*); rufous on the outer webs of the quills barred with dusky. Beneath yellowish white, broadly barred with rufous; tibiæ ochraceous, narrowly, and more faintly, barred. Jugulum always (?) uniform ashy. *Hab.* Panama to Guatemala.

Specimens examined. Nat. Mus., 16; Philad. Acad., 1; Mus. Boston Soc., 1; Cab. G. N. Lawrence, 2. Total, 20.

e. Var. **pucherani** Verreaux.

Esparvero indayé Azara, Apunt, I. 131, No. 30.

Astur magnirostris Hartl., Ind. Azara, p. 2. — D'Orb., Voy. Ois., p. 91.

Nisus magnirostris Burm., P. Z. S. 1868, 623.

Asturina pucherani J. et E. Verreaux, R. Z. 1855, 350. — Scl. and Salv., P. Z. S. 1869, 133.

Falco gularis Licht., in Mus. Berol.

Rupornis gularis Licht., Nomencl., 3.

Asturina gularis Schleg., Mus. de Pays-Bas, *Asturinæ*, p. 4, 1862.

Ch. Wing, 9.40–10.70; tail, 7.00–7.75; culmen, .65–.85; tarsus, 2.40–2.60; middle toe, 1.20–1.35. Ground color of the tail more or less — frequently entirely — light rufous, much lighter than, and very different in color from, the back; crossed with 3–4 — sometimes apparently 5 — narrow bands of black, much narrower than the rufous or grayish. Rufous of the quills narrowly barred with black. Jugulum always (?) striped with brown. Lower parts ochraceous-white, more reddish on the tibiæ, narrowly barred transversely with rufous, of variable shade. Upper parts dusky grayish brown. Lores whitish. *Adult.* Head uniform blackish brown, streaked with white on the throat. *Young.* Whole head striped; tail more grayish.

Hab. Paraguay, Buenos Ayres and Brazil (Mus. S. I.); Bolivia, (Bridges); Prov. Yungas (D'Orb.).

Specimens examined. Nat. Mus., 7; Philad. Acad., 6; Boston Soc., 2. Total, 15.

2. **Buteo (Rupornis) leucorrhous** (Quoy et Gaimard).

Falco leucorrhous Quoy et Gaim., Voy. Uranie, Zool., p. 91, t. xiii.

Nisus leucorrhous Tschudi, F. P. *Aves*, pp. 18, 103.

Asturina leucorrhous Bonap., Consp., p. 80. — Kaup, Isis, 1847, p. 199. — Schleg., Mus. Pays-Bas, *Asturinæ*, p. 5. — Scl. and Salv., P. Z. S. 1869, 134.

Astur leucorrhous Pelz., Orn. Bras., p. 7.

Sp. ch. Wing, 7.80–9.20; tail, 6.00–6.50; culmen, .65; tarsus, 2.25–2.35; middle toe, 1.25–1.30. Fourth to fifth quill longest; first shortest, or intermediate between ninth and tenth. *Adult.* Uniform brownish black; base of tail, upper and lower tail coverts, and lining of the wing, white, the latter with an ochraceous tinge; inner side of tibiæ chestnut-rufous; inner webs of primaries broadly barred with white — sometimes nearly plain black. Tail faintly tipped with grayish, and crossed by 2–3 faintly indicated bars of grayish brown, these white on inner web.

Hab. Northern South America; Brazil, vicinity of Rio, (Mus. Vindob. and S. and G.); Venezuela, (Dyson in Brit. Mus., and Levrandin Mus., Paris); Bogota, N. G., (Mus. S. G.); Peru, (Mus.

Berol. (Localities quoted from Sclater and Salvin, P. Z. S. 1868; p. 134).

List of specimens. Nat. Mus., 3; Philad. Acad., 3; Boston Soc., 2. Total, 8.

Genus GLAUCIDIUM Boie.

Glaucidium Boie, Isis, 1826, 970. (Type *Strix nana* Temm.)
Microptynx Kaup, 1851. (Type *Strix passerina* Linn.)
Microglaux Kaup, 1849. (Type *Strix havanense* Kaup = *G. siju* [D'Orb.] Cab.)
? *Tænioptynx* Kaup, 1849. (Type *Noctua brodiei* Burt.)

CH. Size very small; head rather small; bill and feet very strong and robust; no ear-tufts; tail long, about three-fourths as long as the wing, rounded. Nostrils circular, opening in the middle of the inflated ceral membrane (except in *G. siju*). Tarsus about equal to the middle toe, densely feathered; toes haired. Four outer quills with their inner webs emarginated; 3d to 4th longest. Ear-conch very small, simple, rounded. Bill yellowish (except in *G. phalænoides?*); iris yellow.

Beside the species given in the following synopsis, two others are recognized in Gray's Hand List (Nos. 430 and 432). The *G. phalænoides* Vieill, seems to be a distinct species, and unlike any other, is said to have a black bill!! Its relations seem to be with *G. infuscatum* and *G. pumilum.* It has the crown longitudinally streaked, and the lower parts striped with blackish. The *G. ocellatum* Homb. and J., said to be from Chile, I have not seen.

SYNOPSIS OF AMERICAN SPECIES AND RACES.

Common characters. Above brown, varying from nearly gray to bright ferrugineous, interrupted by a more or less distinct nuchal collar of whitish or reddish, with an adjacent blackish spot, more or less observable. Tail with narrow bands. Beneath white, nearly immaculate medially, but laterally variegated with numerous markings, of various direction and color. Throat and jugulum white, with a dusky collar between. Pileum speckled or streaked with lighter. Wings more or less spotted.

A. — Nostril opening in the middle of the inflated cere.
  a. Markings on the crown circular, or dot-like.
    1. G. PASSERINUM. Tail grayish-brown, or dusky-brown, with 6–8 narrow white bands. Sides of the breast

parts varying from speckled with lighter. Upper brownish gray to chocolate-brown; ground-color of the lower parts pure white.

Tail, and stripes on sides, not darker than the back; tail-bands 6, and continuous; toes rather thickly feathered, wing, 3.90; tail, 2.20; culmen, .55; tarsus, .50. *Hab.* Northern portion of the Palæarctic Realm.

. . . . var. *passerinum*.

Tail, and stripes on the side, much darker than the back; tail bands 7 (♂) – 8 (♀), not continuous; toes only scantily haired; wing, 3.50–4.00; tail, 2.50–2.80; culmen, .43–48; tarsus, .60; middle toe, .55. *Hab.* Western Province of Neartic Realm (Pacific coast and Arizona; Mus. S. I.; Colorado; Aiken; Mexico—table-lands? Coll. G. N. Lawrence).

. . . . var. *californicum*.

2. G. PUMILUM. Tail dusky brown, or brownish black, with 4–5 white or whitish bands, these composed of spots, most distinct on the inner webs. Sides of the breast not speckled with lighter. Above, chocolate-brown, the head more grayish. Stripes on the sides more rufescent. Wing, 3.30–3.70; tail, 2.10–2.15; culmen, .40; tarsus, .50; middle toe, .60. *Hab.* Tropical America, from Brazil to Guatemala.

3. G. LANSBERGII. Tail dark brown, with 7–8 continuous bands of bright rufous. Sides of the breast with or without lighter spots. Above bright ferruginous, with transverse bars of lighter; beneath, light rufous, the stripes on the sides deeper rufous. Wing, 4.10–4.20; tail, 2.80–2.90; culmen, .45; tarsus, .70; middle toe, .70. *Hab.* Brazil.

4. G. JARDINI. Tail deep black, with seven transverse series of elliptical spots of pure white. Sides of the breast with transverse spots of whitish; sides almost continuous umber-brown, variegated with irregular longitudinal spots posteriorly. Above, very dark sepia-brown, variegated on the wings and scapulars with transverse spots or bars of whitish. Wing, 3.90–

4.20; tail, 2.70; culmen, .45; tarsus, .75; middle toe, .70. *Hab.* New Granada to Guiana.

b. Markings on the crown in form of longitudinal streaks, or lines.

5. G. FERRUGINEUM. Tail dark brown, crossed by 7–9 continuous bands of bright rufous, about the same width as the brown ones. Above, varying from grayish brown to bright ferrugineous, without lighter transverse bars on the dorsal region; beneath, varying from pure white to pale rufous, the stripes on the sides grayish brown, or rufous. Sides of the breast never speckled with lighter. Wing, 3.70–4.15; tail, 2.20–2.90; culmen, .45–.50; tarsus, .70–.80; middle toe, .70–.75. *Hab.* Tropical America, from southern border of U. S., (Arizona, Bendire; and probably Texas) to southern Brazil. Both coasts of Middle America, but apparently only the Atlantic slope of South America.

6. G. INFUSCATUM. Tail dark brown, crossed by 6–7 non-continuous bands of white, narrower than the dark ones. Above, varying from grayish brown to reddish umber and sepia (apparently never rufous). Beneath white, the stripes on the sides grayish brown, or dark brown. Sides of the breast not speckled.

Above, dark sepia, or blackish brown. Tail brownish black, or deep black. Wing, 3.70–3.90; tail, 2.50–2.90; culmen, .45; tarsus .65–.80; middle toe, .65–.70. *Hab.* Eastern South America (Paraguay to New Granada). . . . . var. *infuscatum.*

Above, grayish, or reddish, umber. Tail clear dark brown, or grayish umber. Wing, 3.60–3.90; tail, 2.35–2.75; culmen, .45–.50; tarsus, .65–.80; middle toe, .60–.70. *Hab.* Whole of Middle America, from the Rio Grande (perhaps in Texas) to Panama. . . var. *gnoma.*

7. G. NANUM. Tail brown, crossed by 8–12 continuous bands of reddish white, or rufous, not more than half as wide as the brown ones. Brown of the sides much broken anteriorly by white spotting, and forming

longitudinial stripes only on the flanks. Above, grayish brown, varying to rufous-brown (the back always more ashy) the wings with white spotting. Wing 4.00–4-60; tail, 3.00–3.25; culmen, .50; tarsus, .70; middle toe, .70. *Hab.* Chile. (Straits of Magellan and Peru, Kaup.)

B. Nostril opening in the anterior edge of the inflated cere (*Microglaux* Kaup).

8. G. SIJU. Crown with diamond-shaped, rather longitudinal, dots of lighter. Nuchal collar rufous, in abrupt contrast. Tail dark brown, crossed by 6–7 continuous narrow bands of reddish white, less than half as wide as the brown. Markings on the sides in form of transverse spots, but arranged in longitudinal series. Above, grayish umber, with transverse, partly concealed, spots of ochraceous or white. Wing, 3.50–4.00; tail, 2.30–2.60; culmen, .40–.50; tarsus, .62–70; middle toe, .62–.75. *Hab.* Cuba.

1. **Glaucidium passerinum** var. **californicum.**[1]

Glaucidium californicum Sclater, Proc. Zool. Soc., Lond., 1857, p. 4.

Glaucidium passerinum var. *californicum* Ridgway, Coues, Key, 1872, 206.

Strix passerinoides (not of Temminck!) Aud., Orn. Biog. v, 271, 1831.

Glaucidium infuscatum (not of Temm.!) Cass., Birds of Cal. and Tex., p. 189, 1854. Newb., P. R. R. Rept. VI, iv, 77, 1857.

Glaucidium gnoma (not of Wagler!), Cass., Birds N. Am. 1858, 62. Heerm., P. R. R. Rept. VII, 31, 1857.—Coop. and Suck., P.

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[1] **Glaucidium passerinum** var. **passerinum** Linnæus.

Strix passerina Linn., S. N. I, 1766, 133.

Glaucidium passerinum Boie, Isis, 1826, 976.—Sharpe and Dresser, B. Europe, II, April, 1871.

Surnia passerinum Keys and Blas., Würb. Eur. 1840, 32.

Microptynx passerinum Kaup, Contr. Orn. 1852, 107.

Noctua passerinum Schleg., Mus. Pays-Bas. *Striges*, p. 41, 1862.

Strix pusilla Daud., Tr. Orn. II, 1800, 205.

Strix pygmæa Bechst., Nat. Deutschl. IV, 978, t. XXIV, 1805.

Strix acadica Temm., Man. d'Orn. I, 1820, 96 (not *Strix Acadica* of Gmelin!)

List of specimens examined. Nat. Mus., 1; Philad. Acad., 3: N. Y. Mus., 1. Total, 5.

R. R. Rept. XII, ii, 158, 1860. — Coues, Prod. Orn. Ariz., p. 14, 1866. — Cab., Journ. 1862, 336. — Lord., Int. Obs. 1865, 409; (Habits). — Gray, Hand List, I, 42, 1869. — Cab., Ueb. Berl. Mus. 1869, 207.

Hab. Western Region of N. Am., from Oregon southward; Arizona (F. Whipple, Coues); Colorado (El Paso Co., Aiken); Table lands of Mexico. (Coll. G. N. Lawrence.)

Description.

Sp. ch. *Adult male* (12054, Puget's Sound, Washington Ter.; Dr. C. B. Kennerly). Above, including the auriculars, umber-brown, with a faint reddish cast, this tinge most apparent in a sharply defined band across the throat; the continuity of the brown above is interrupted by a scarcely observable collar round the nape, of concealed whitish, which can only be detected laterally, where there is also an inconspicuous black space. Whole head above and neck behind, with numerous small circular spots of reddish white; back scapulars and wings, more sparsely and more minutely marked with the same, the two or three lower feathers of the secondary-coverts, with each a terminal, somewhat oval, larger spot of pure white. Secondaries crossed (exposed) bands of pure white, and narrowly tipped with the same, the bands formed by semi-circular spots on the outer webs. Primaries almost plain, but showing faintly defined obsolete bands, the 3d, 4th, and 5th, with two or three conspicuous white spots on outer webs, beyond their emargination; primary-coverts perfectly plain. Tail considerably darker than the wings, crossed with *seven* narrow bands of pure white, the last of which is terminal and not well defined; these bands are formed by transverse *spots not touching the shaft on either web.* Lores, sides of the forehead, sides of the throat (beneath the cheeks and ear-coverts) and lower parts in general, pure white, the ante-orbital white continuing back over the eye to its middle, but not beyond it. Lateral portion of the neck and breast (confluent with the gular belt), and sides, umber, like the back, but more numerously, though less distinctly speckled — the spots rather larger and more longitudinal on the sides. Breast, abdomen, anal region and lower tail-coverts with narrow longitudinal stripes of nearly pure black. Jugulum immaculate. Tarsi mottled on the outside with brown. Lining of the wing white, with a transverse patch of blackish across the ends of the under primary-coverts, formed by a terminal deltoid spot on each feather; a blackish stripe, formed of blended streaks (parallel with the edge of the wing) running from the bend, to the primary-coverts. Under surface of primaries dusky, with transverse spots of white anterior to the emargination, these white spots being *eight* in number on the longest quill; axillars plain white. Wing, 3.60; tail, 2.60; culmen, .45; tarsus, .60; middle toe, .55. Wing-formula 4, 3, 5–2, 6, 7, 8, 9, 10, 1.

Adult female (36874, Ft. Whipple, near Prescott, Arizona, Oct. 11, 1864; Dr. Coues). In general appearance scarcely different from the male. Upper surface more *ashy*, the specks of whitish less numerous, being confined chiefly to the head; those on the scapulars however, are large, though very sparse; the middle wing-coverts have each a conspicuous roundish white spot near the end of the lower web; secondary-coverts similarly marked, forming a band across the wing. The primaries and tail are as in the male, except that the latter has *eight* instead of seven white bands. The brown of the gular band extends upward over the throat to the recurved feathers of the chin; the white dots in the brown of the side are considerably larger, and though very irregular, are more circular than in the male; the stripes on the abdomen, etc., are rather broader, and less deeply black, than in the male. Wing, 4.00; tail, 2.80; culmen, .48. Wing formula as in male.

One specimen in the S. I. collection (No. 59069) differs from those described in being much darker colored. The original label is lost, but this specimen is probably from the northwest coast, as the darker, more reddish colors, bear about the same relation to the paler gray suits of the southern birds, that the dark northwest coast style of *Scops asio* (*S.* "*kennicottii*"), does to the true *asio*. The stripes beneath are nearly pure black, the general tint above being a reddish sepia-brown. Wing, 3.65; tail, 2.70.

The *Glaucidium californicum* requires comparison only with the *G. passerinum* of Europe, to which it is quite closely related, though from which it is easily distinguished by the characters pointed out in the diagnoses. It is not at all like *gnoma*, nor indeed any other American species, with which it has been confounded by nearly all ornithologists — even by Cabanis, in his excellent paper above cited.

I have seen only one Mexican specimen of this species. This one is one in Mr. Lawrence's collection; the locality is not indicated on the label, but it is probably from the higher regions of the interior.

It differs in no respect, except in size, from N. American examples; it measures, wing, 3.40; tail, 2.60.

Specimens examined. Nat. Mus., 7; Philad. Acad., 2; Cab. G. N. Lawrence, 2; Coll. R. Ridgway, 1. Total, 12.

2. Glaucidium pumilum.

" *Strix pumila* Illig." Temm., Pl. Col., 344, 1821.

Athene pumila Gray, Gen. B. 35, No. 14, 1840.

Glaucidium pumilum Kaup, Monog. Strig. in Cont. Orn. 1852, 103. — *Id.* Trans. Zool. Soc. 1862, 202. — Gray, Hand List, I, 1869, 42, No. 429. — Burm., Thier. Bras. II, 144, 146. — Caban., Ueb. Berl. Mus. 1869, 208.

Strix minutissima Max., Reis. Bras. 1820. — *Id.* Beitrag, III, 242.

Surnia minutissima Bonap., Os. Cuv. Règ. An., 57. — *Id.* Isis, 1832, 1035.

Athene minutissima Bonap., Consp. Av., 38.

? *Strix ferox* Vieill., Nouv. Dict. VII, 22, 1817. — *Id.* Enc. Méth. III, 1289, 1823.

Noctua ferox D'Orb., Synop. Av. Mag. Zool. 1838.

Athene ferox Bridg., P. Z. S. Pt. II, 109. — *Id.* Ann. N. H. XIII, 500.

Hab. Northwestern and eastern South America (New Granada, Equador and Brazil); Guatemala (Coll. of G. N. Lawrence).

Description.

Sp. ch. *Adult male* ("South America"; Collection of Philadelphia Academy). Above, deep chocolate-brown; head and neck above with minute circular specks of pale yellowish; nape with an interrupted collar of whitish. Secondary coverts with a few ochraceous spots on margins of outer webs, and secondaries with about three obscure bands of the same; inner webs of tertials with conspicuous indentations of ochraceous. The fourth and fifth primaries with one or two very small spots of pale rufous beyond their sinuation. *Tail brownish black*, crossed with four series of rounded *white* spots (these not touching the shafts of the feathers), the last terminal. Ground color of lower parts pure white; gular collar, whole sides of breast (continuously) and broad longitudinal stripes on sides and flanks, *bright rufous*, or rufescent chocolate; tibiæ and upper portion of tarsi inclining to the same. Wing, 3.90; tail, 2.15; tarsus, .50; middle toe, .60.

Another example (236, Phil. Acad. Coll.) differs only in *clearer* brown of the head, narrower rufous stripes below, and paler legs. A specimen in Mr. Lawrence's collection, from Guatemala, is partly in the immature plumage; in this the head above and nape are gray tinged with chocolate, and without spots; the rest of the plumage, however, is adult, and is much as described above, except that the stripes beneath are less rufescent, — only a little more so than the back. The size is also a little smaller, measuring, wing, 2.30; tail, 2.10.

A young specimen from Guatemala, in the collection of the Boston Society of Natural History, is in all respects exactly like the preceding, except that it shows indication of narrow *longitudinal* streaks on the sides of the crown.

There can be no doubt that this is the species of Temminck, as his figure, above cited, agrees unmistakably with the specimens before me.

Specimens examined. Museum Boston Society, 4; Philad. Acad., 2; N. Y. Mus., 3; Cab. G. N. Lawrence, 1; Coll. R. Ridgway, 1. Total, 11.

3. Glaucidium langsbergii.

"*Glaucidium langsbergii* T. B. Wilson." (Manuscript name on specimens in the collection of the Philadelphia Academy.)

Hab. Amazon and Orinoco region of South America.

Description.

Sp. ch. *Adult male* ("Brazil"; Coll. Philad. Acad.). Prevailing color, deep dark ferrugineous, more dusky on the primaries and tail; beneath, including the lining of the wing, lighter, or ochraceous-rufous. Sides of the nape with a conspicuous transverse spot of black. Whole upper surface, with conspicuous transverse spots, or bars, of lighter, brighter rufous, the head above and nape with small rounded spots of the same. Tail with seven deep rufous continuous bands, these about equal in width to the dusky ones. Maxillæ, chin and pectoral spot (only) pure white; gular collar and whole side of the breast dark ferrugineous, and sides with a nearly continuous wash of the same, changing toward the abdomen and on the flanks into indistinct longitudinal stripes, considerably darker than the ground-color. Wing, 4.20; tail, 2.80; tarsus, .70; middle toe, .70.

Adult female (249, Caracas, Venezuela; Coll. Philad. Acad.).

Head anteriorly nearly white; lateral lower parts more spotted; cervical black patch more conspicuous. Wing, 4.10; tail, 2.90.

A specimen in the collection of Mr. Lawrence is almost perfectly similar to those described, except that the spots on the crown are more distinct, and there are eight rufous bands on the tail, including the extreme basal and the terminal ones. Its habitat is queried as Brazil, which is probably correct. It measures, wing, 4.10; tail, 2.60; culmen, .45.

This species is perfectly distinct from any other described in this work. For its name we are indebted to the manuscript label by Dr. Wilson, who quotes "Leyd. Mus." The identification by this gentleman being generally entirely trustworthy, we feel safe in retaining the name above given.

Specimens examined. Philad. Acad., 2; Cab. G. N. Lawrence, 1. Total, 3.

4. Glaucidium jardinii?

? *Phalænopsis jardinii* Bonap., Comp. Rend. XLI, 1853 (♀).
Glaucidium jardinii Caban., Ueb. Berl. Mus. 1869, 208.

Hab. Northern South America; New Granada (Bogota Nat. Mus.); Guiana (Cab. G. N. Lawrence).

Description.

Sp. ch. *Adult male* (24887, Bogota; L. de Geoffroy). Whole upper parts, gular collar, sides of the jugulum, and lateral lower parts, very dark, rich sepia-brown; the head above, and nape, rather less reddish. Cheeks, pectoral space, and abdomen, medially, pure white. Head above and laterally, and neck, with numerous circular dots of white; sides of the breast, scapulars and wings, with transverse bars of rusty white; secondaries with five bands of pale fulvous, these not touching the shaft; primaries with five or six spots of dull fulvous — those beyond the sinuation of the quills almost white. Tail deep black, with six or seven (seven on the inner and six on the outer webs — two concealed) bands of pure white, formed by transverse elliptical spots which do not touch the shaft. Sides almost uniformly dark sepia-brown, with irregular, nearly concealed, spots of paler; lower tail-coverts with medial large spots of blackish brown; legs thickly barred with the same. Nuchal collar conspicuous, pure white and deep black, the latter nearly continuous. Wing, 3.90; tail, 2.80; tarsus, .75; middle toe, 70.

Adult female (24888, Bogota; L. de Geoffroy). Similar, but not quite so dark, there being considerable contrast between the sepia-brown of the general upper surface and the black cervical collar. Tail with six bands, similar to those of the male. Wing, 4.20; tail, 2.70; tarsus, .75; middle toe, .70. Wing formula, 5, 4, 3 = 6–7–8–2; 1st shortest.

A specimen from Guiana, in the collection of Mr. G. N. Lawrence, is exactly similar to No. 24887, except that the white of the lower parts and lining of the wing are tinged with fulvous.

I am not positive that these specimens represent the true *G. jardinii* of Bonaparte, since there are several minor discrepancies between his description of that species and the characters of the birds here described. Considering, however, that they correspond quite closely with the description cited, and that they are from the same locality as the type, I prefer retaining, provisionally at least, the name given above, to risking a new one on uncertain grounds.

Specimens examined. National Museum, 2; Philad. Acad., 4; G. N. Lawrence, 1. Total, 7.

5. Glaucidium ferrugineum.

Strix ferruginea Max., Reis. Bras. I, 105; 1820; Trav. Bras., p. 88; Beitr. III, 234. — Temm., Pl. Col. 199. — Lath., Gen. Hist. I, 373.

Noctua ferruginea Steph., Zool. XIII, pt. 2, p. 69. — Less., Man. Orn. I, 111; Tr. Orn., 104. — Cuv., Règ. An. ed. 2, I, 346. — Tschudi., Av. Consp. Weigm. Archiv. 1844, 267; Faun. Per., pp. 19, 117.

Surnia ferruginea Bonap., Oss. Cuv., Règ. An., p. 56; Isis, 1833, 1053.

Athene ferruginea Gray, Gen. B. fol. sp. 17; List B. Brit. Mus., p. 92. — Bonap., Consp. Av., p. 38. — Strickl., Orn. Syn. I, 162; 1855.

Glaucidium ferruginea Kaup, Mon. Strig. Cont. Orn. 1852, 104. — Burm., Thier. Bras. II, 141, 146. — Caban., Ueb. Berl. Mus. 1869, 206. — Coues., Am. Nat. VI, 370 (Arizona). *Id.* Key. 1872, 206.

?*Athene nana* (King) Gray, Gen. 1844, pl. VII. (Normal plumage.)

Hab. Whole of eastern South America, and Central America (both coasts) northwards into southern border of U. S., (Arizona. Bendire; probably entire southern border!).

Description.

Adult male (23792, Mazatlan, Mexico; J. Xantus).

a. — *Normal plumage.*

Upper surface umber-brown, more ashy anteriorly — posteriorly more brownish. Head above, with a few narrow *longitudinal lines* of yellowish white, anteriorly and laterally; a quite distinct collar of whitish spots across the nape, the black lateral spaces rather indistinct. Scapulars with a few conspicuous oval spots of pure white; two lower feathers of secondary coverts, each with a similar spot on outer web. Secondaries darker brown, crossed with five bands of dull rufous, the last not terminal; outer webs of primaries with semicircular pale spots along the margin, which are nearly white beyond the sinuation of the feathers, and brownish anteriorly. *Tail bright rufous*, crossed with about seven distinct bands of dark brown, these hardly equalling the rufous in width, which is also terminal. Longitudinal stripes of the sides, of the same soft grayish brown tint as the head; tarsi sparsely speckled with the same on outer side. *Wing-formula* 4, 5, 3–6–7, 2, 8; 1st shortest. Wing, 3.70; tail, 2.20; culmen, .45; tarsus, .70; middle toe, .70.

b. *Rufescent plumage.*

Upper surface continuously deep lateritious-rufous, all the lighter markings almost obliterated. Bars on the tail scarcely traceable. Black cervical transverse space conspicuous. Sides of the breast, and stripes of the sides duller rufous than the tint above, white of ground color with yellowish tinge. Legs pale rufous, deepest on outer side — immaculate. Gular collar blackish.

♂, 43055, La Palma, Costa Rica, Jan. 27, 1866, José Zeledon. Wing formula, 4 = 5, 3–6–2; 1st shortest. Wing, 3.80; tail, 2.40.

♀, 33216, San José, Costa Rica; J. Carmiol. Wing formula, 4, 3= 5–6, 2; 1st shortest. Wing, 4.15; tail, 2.90; tarsus, .80; middle toe, .75.

The very numerous specimens examined, are from the Rio Grande of Texas, (across the whole breadth of middle America) to Paraguay — everywhere the same bird, specimens from the most remote parts of its range being not appreciably different from each other.

A specimen of the ferrugineous plumage, in the collection of the Philadelphia Academy, is remarkable for the great intensity and uniformity of the rufous — the entire plumage, in fact, being of this color, a fine light tint of which replaces the white below. There is no trace of bars, on either wings or tail. In the very large series before me, I find in individuals every possible shade between the two extremes described.

Specimens examined. National Museum, 35; Philadelphia Academy, 17; N. Y. Mus., 4; Mus. Cambridge, 2; Cab. G. N. Lawrence, 1; Coll. R. Ridgway, 2. Total, 61.

6. Glaucidium infuscatum.

a. var. infuscatum.

Strix infuscata Temm., Ind. Général, 1821. — *Id.* Man. Orn. I, 97 (sub *acadica*).

Athene infuscata Bonap., Consp. 37, 1850 (excl. syn.).

Glaucidium infuscatum Kaup, Monog. Strig. in Cont. Orn. 1852, 103. — Cabanis, Ueb. Berl. Mus. 1869, 207.

? Strix eluta Illig. in Mus. Berl. Cab. Az., No. 49.

Strix passerinoides Temm., Pl. Col. 344.

Surnia passerinoides Bonap., Os. Cuv. Règ. An. I, 57.

Noctua passerinoides Less., Tr. Orn. and Man.

Hab. Eastern South America.

Description.

Adult (50947, Brazil; Sr. Don Fred. Albuquerque).

Upper surface dark umber, inclining to clove-brown, becoming more rufescent on rump and upper tail-coverts; head above with longitudinal lines of yellowish white; scapulars and wing coverts with a very few roundish spots of white; spots on outer webs of primaries very obscure, not approaching white. *Tail brownish-black*, crossed with seven series of transverse ovate spots of *white*, these touching neither the shaft nor edge of the feathers. Sides of the breast and stripes on the sides and crissum somewhat lighter and less fuliginous brown. Wing, 3.70; tail, 2.60; tarsus, .70; middle toe, .65. Wing formula, 3, 4, 5–6 = 2; 1st shortest.

This specimen unquestionably represents the true *infuscatum* of Temminck. The present bird and the *gnoma* Wagl. of Middle America seem to be merely two races of the same species, and distinguishable only by the darker brown and greater restriction of white in the present bird. In both there is exactly the same size and proportion, and the same pattern and tints of coloration, distinguishing them from all the other species.

A specimen (No. 807) in the collection of the Boston Society differs in distinct pale ochraceous spots over whole upper parts; the brown above is of a more reddish, or sepia, shade. A specimen (No. 8063) in the Museum of Comparative Zoology is intermediate between this and the type.

Specimens examined. Nat. Mus., 1; Philad. Acad., 3; Boston Soc., 3; Mus. Comp. Zool., 1; N. Y. Mus., 1. Total, 9.

b. var. **gnoma** Wagler.

Glaucidium gnoma Wagl., Isis, 1832, p. 275. — Kaup, Monog. Strig., Cont. Orn. 1852, 103 (sub *G. infuscatum*). — Strickl., Orn. Syn. I, 163, 1855 (sub *G. infuscatum*).

Athene gnoma Gray, Gen. B. fol. sp. 35, 1844.

Hab Middle America, from Isthmus of Panama northward to the Rio Grande (perhaps into southern border of the United States); both coasts of Mexico (numerous specimens from Yucatan and Mazatlan); Honduras (Coll. G. N. Lawrence).

Description.

Adult. Above, ashy umber, much as in *californicum*, but upper tail-coverts and rump more rufescent. Head above with numerous sharply defined *longitudinal lines* of clear white. Spots of nuchal collar conspicuous. Scapulars with concealed, large roundish spots of white; lower wing-coverts with irregular white spots. Secondaries scarcely darker than the back, crossed by 5 (exposed) narrow bands of pale brown becoming white exteriorly; primaries darker than secondaries, outer webs with irregular spots, — those beyond the sinuation of the quill nearly white, the basal ones dull brown; there are seven on the largest quill. *Tail, dark brown* (considerably darker than the primaries) with seven (♂) to eight (♀) *bands of pure white*, the transverse spots forming these bands, not touching the shafts of the feathers, though running out to the edge of the web. Sides of the breast and stripes of the sides and lower tail-coverts paler grayish brown than the color above.

♂, 49,154, San Salvador, Central America; Mr. Hardiman. Wing formula, 3, 4, 5–2, 6; 1st shortest. Wing, 3.60; tail, 2.35; culmen, 60; tarsus, .65; middle toe, .60. Tarsi spotted; tail with seven white bars.

♀, 37,876, Merida, Yucatan, Mar. 6, 1865; José Salazar Llarregui; Arthur Schott. Wing formula, 4, 5, 3–6, 2; 1st shortest. Wing, 3.90; tail, 2.60. Tarsi spotted on outer side. Tail slightly tinged with reddish.

The ground color varies to reddish chocolate, of much the same shade as *G. pumilum;* but the stripes beneath darker than the back, instead of lighter and reddish, the longitudinal instead of the circular markings on the crown, the black cervical half collar and greater number of tail bands (seven or eight instead of four) will serve to easily distinguish this species.

Specimens examined. Nat. Mus., 6.

7. Glaucidium nanum.

Strix nana King, Zool. Journ. III, 427, 1828.

?? *Athene nana* Gray, Gen. B., p. 35, No. 15, tab. 12, 1844.

Glaucidium nanum Boie, Isis, 1826, p. 976. — Kaup, Monog. Strig. Pr. Zool. Soc. IV, 202, 1859. — Hartl., Naumannia, 1853, p. 209. — Burm., Th. Bras. II, 146. — Cabanis, Ueb. Berl. Mus. 1869, 206.

Strix chilensis Licht. in Mus. Ber.

Hab. Chile.

Description.

Adult male (48834, Santiago, Chile, Oct., 1858; Nat. Mus., Chile, Dr. Philippi, Director).

Upper surface ashy umber, much as in *G. infuscatum* var. *gnoma*; the back, however, decidedly more ashy than the portion anterior to the nuchal collar. Head above anteriorly, with *longitudinal lines* of white, these becoming gradually broader, or drop-shaped in form, posteriorly, where they are also more rusty in tint; white spots of the nuchal collar conspicuous, but the black rather obscure, confined to an oblong space on each side of the nape; scapulars with a few concealed, sharply defined, white roundish spots; middle wing-coverts each with a more conspicuous one, on outer web; secondaries with about five bands formed by white spots along the edge — the last not terminal; five outer primaries, with spots of white on outer webs, (there being six on the longest) — these most conspicuous after the sinuation of the quill. Tail brown, lighter than the primaries, crossed by ten very narrow, but perfectly continuous, bands of *pale, dull rufous*, (this passing into white on the edge of the feather) — the last broadest, and terminal. Cheeks, chin, pectoral area, and abdomen medially, pure white. Sides of the breast, sides and flanks, of a brown tint similar to the upper parts; the brown markings on the sides of very irregular form, assuming the shape of badly defined longitudinal stripes, posteriorly; anteriorly, it is much broken up by numerous irregular, but somewhat roundish, indistinct spots of white. Legs strongly clouded (especially on outer side) with brown; lower tail-coverts, each with a narrow medial stripe of brown.

Wing formula, 4 = 5, 3–6–2, 7; 1st shortest. Wing, 4.00; tail, 3.00; culmen, .50; tarsus, .70; middle toe, .70.

Adult female (48835, Santiago, August, 1864. Nat. Mus. Chile) very similar to the male. Anterior portions above, more reddish; tail with ten wider bars of deeper rufous, (the rufous bars about half as wide as the brown). Wing, 4.50; tail, 3.25. Wing formula, 4 = 5, 3–6, 2; 1st shortest.

Specimens examined. Nat. Mus., 3; Boston Soc., 4; Philad. Acad., 4; Mus. Cambridge, 1. Total, 12.

9. **Glaucidium siju.**

Noctua siju D'Orb., R. Sagra, Cuba. Aves, tab. 3, 1839.
Athene siju Gray, Gen. B. p. 35, No. 25, 1840.
Nyctale siju Bonap., Consp. Av., p. 54, No. 25, 1850.
Glaucidium siju Caban., Journ. für. Orn. 465, No. 20, 1855; Ueb. Berl. Mus. 1869, 207.
Strix havanensis Licht. in Mus. Berl.
Glaucidium havanense Kaup, Monog. Strig., p. 204, sp. 5.

Hab. Cuba (only?).

Description.

Adult male (39113, Remedios, Cuba, Feb. 8, 1865; N. H. Bishop). Upper surface umber; nape crossed by a broad collar of plain fine light rufous; an oblong isolated black space on each side of the neck, anterior to the rufous. Head above, and nape, with numerous diamond-shaped specks of white; scapulars and wings with transverse spots, or bars, of white; secondaries crossed with four bands of pure white, formed of indentations along the margin; primaries with a few spots of pure white, these most conspicuous near the sinuation. Tail brown (lighter than the primaries), crossed by about six very narrow, but perfectly continuous, bars of white — the last terminal. Beneath, pure white; gular collar reddish brown; sides of the breast, sides and flanks, with numerous, detached, rather *transverse* spots of deep brown, with a rufous cast. Rest of lower parts, immaculate pure white. Wing formula, 4 = 5, 3–6, 2, 7; 1st shortest. Wing, 3.50; tail, 2.30; culmen, .41; tarsus, .62; middle toe, .65. Length

5.65; extent 12. "Eyes chrome-yellow; feet greenish yellow, chrome yellow beneath; tail greenish yellow."

Adult female (35554, N. Sophia, Cuba, Jan. 25, 1861; Charles Wright).

Markings on head above, very indistinct, and more longitudinal; nuchal collar less distinct, and dull rufous. Upper parts in general plain brown; white of secondaries running irregularly along the edge, instead of forming separate bands. Tail with six very distant, narrow, continuous bands of white, the last terminal. Markings beneath in form of *transverse* spots, running in longitudinal series, their tint bright rufous, upon a snow-white ground. Under surface of primaries anterior to their emargination, immaculate pure white. Wing, 3.70; tail, 2.60.

Specimens examined. Nat. Mus., 5; Boston Society, 2; Philad. Acad., 1; Cab. G. N. Lawrence, 2. Total, 10.

DESCRIPTION OF SOME NESTS AND EGGS OF ARIZONA BIRDS.

BY T. M. BREWER, M.D.

During my brief visit to St. Louis a few weeks since, I had an opportunity to make the acquaintance of Capt. Charles Bendire, and to examine his very interesting collections in Oology, made in Southern Arizona in the spring and summer of 1871. Capt. Bendire devoted himself to the study of the breeding habits of the birds of that region with a rare zeal and industry, and has been rewarded in the discovery of an unusually large number of nests and eggs before wholly unknown. Some of these I propose to briefly describe.

Buteo montanus. Western Red-tailed Hawk.

This hawk was abundant in Arizona. It was found breeding as early as the 6th of April. A nest was built in a large cotton-wood tree, and was placed close to the trunk. It was composed of sticks mingled with strips of the bark of the cotton-wood tree. The eggs, two in number, in shape are of a rounded oval, a little more obtuse at one end than at the other, and measure 2.39 inches in length by 1.85 inches in breadth. The ground color is a chalky white, marked with a few scattered, irregularly shaped plashes of a light reddish-brown, intermingled with a few tinged with a purplish shade. These blotches are larger and more numerous at the obtuse end. All the eggs in the collection of Capt. Bendire closely corresponded with the one I have described, and none of them are like any egg of the *Buteo* *borealis* that I have ever seen. It is common to regard the *montanus* and the *borealis* as races of the same species. Without entering into the merits of this question, I may note that their eggs do not favor this supposition.

Asturina plagiata. Gray Hawk.

The meeting with the nest and eggs of this rare hawk was one of the most important and interesting of his discoveries. The nest was found June 6th, and was slightly built of sticks and strips of bark. It was in a low tree on the banks of Reledo Creek, near Tucson, Arizona. The egg is of a rounded oval shape, quite tapering at one end, and rounded at the other. It is of a uniform bluish-white color, and unspotted. The egg measures 2 inches in length by 1.60 inches in breadth.

Pyrocephalus mexicanus. Red Flycatcher.

The nest and eggs of this species were first obtained in Mexico by Mr. John Xantus, and two specimens of the latter are in the collection of the Society. No description of them has, however, been made public. Capt. Bendire found them quite abundant in southern Arizona. They were found breeding as early as April. They were most common in the neighborhood of Reledo Creek, near Tucson, and were generally found in the vicinity of water. Their nests were found in various situations. In one instance it was in a cotton-wood tree, thirty feet from the ground. In other instances, in the fork of a mesquite not more than ten feet above the ground. The nests were small, slight and loosely constructed, and not readily preserved, made externally of twigs, fine bark, stems of plants, etc., and lined with hair and feathers. The usual number of eggs was three, never more. These bear a close resemblance, except in size, to the eggs of *Milvulus forficatus.* Their ground is a rich cream color, to which their deep purplish brown markings seem to give a slight tinge of red. The markings are few, bold and conspicuous, and encircle the larger end with an almost continuous ring. In shape they are of a roundish oval, and measure .66 of an inch in length by .55 of an inch in breadth.

Helminthophaga luciæ. Arizona Warbler.

The discovery of the nest and eggs of this new warbler is also an interesting addition to zoological knowledge. This warbler was first discovered and described by Dr. Cooper, in 1862, and is not included in Prof. Baird's Pacific Railroad Report. Nothing was known of its breeding habits until discovered by Capt. Bendire. His first nest was taken May 19, 1872. Unlike the other species of this genus, which, so far as is known, build their nests on the ground, this little warbler was found nesting in the manner of the common Grey Creeper, under the loose bark of the trunk of a dead tree, a few feet from the ground. The eggs also bear a great resemblance to those of the Creeper, but are of course smaller. In shape they are nearly spherical, their ground is of a crystal whiteness, spotted, chiefly around the larger end, with fine dotting of a purplish red, and measuring .54 of an inch in length by .45 in breadth.

Pyranga hepatica. Rocky Mountain Tanager.

Two eggs of this species measure 1.02 inches in length by .67 of an inch in breadth; the other .95 by .70 of an inch. Their ground color is a pale light green. One is somewhat sparingly marked over the entire egg with very distinct and conspicuous blotches of purplish brown. The other egg is much more generally covered with finer dottings of the same hue, and so numerous as partially to obscure the ground. The eggs are of an oblong oval shape, rounded and nearly equal at either end.

Harporhynchus crissalis. Red-vented Thrush.

The eggs of this species were first discovered by Dr. Palmer, in Arizona. They have been since met with by Capt. Bendire, and confirm the anomaly of their markings. They are unlike the eggs of any other known member of this genus, and are of a light robin-blue color, unspotted, and hardly distinguishable from the egg of our common robin, *Turdus migratorius.* They are of an oblong oval shape, rounded, and nearly equal at either end, and measure 1.10 inches in length by .75 of an inch in breadth.

Harporhynchus curvirostris. Variety *Palmeri.*

Two sets of eggs taken, one July 18th, the other Aug. 2d. Both nests were built in cactus plants, a few feet from the ground. The eggs in each instance were three in number. Their ground color is a light blue, generally and profusely sprinkled with fine dottings of a light golden brown. They are of an oblong shape, tapering at one end, and rounded at the other, and measure 1.10 inches in length by .82 of an inch in breadth. A nest of this species was also found in Arizona by Dr. Palmer, corresponding in all respects with those found by Capt. Bendire.

Harporhynchus bendiri.

The nest from which these eggs were taken was found July 19th, 1872. It was built in a mesquite bush, or low tree, and was five feet from the ground. It was quite flat, and resembled the usual nests of the *curvirostris*. It contained two eggs, which were quite fresh. These eggs are essentially different in their ground color and marking from those of every other member of this genus except *H. cinereus*, and these they only very slightly resemble. They have a ground of a light and rather brilliant clay color, or grayish white, marked chiefly around the obtuse end with large and well marked dashes of reddish-brown, and a brownish lilac. They are oblong oval in shape, and nearly equally rounded at either end. They measure 1.10 inches in breadth by .75 of an inch in breadth. They have a strong resemblance to the eggs of *Pyrrhuloxia sinuata* (Bon.).

Myiadestes townsendi. Townsend's Flycatcher.

The nest was found May 24th, 1872, built in a low tree. It was a shallow, nearly flat structure, and contained two eggs. These eggs are of very peculiar and well marked characteristics, resembling no other egg that I can now call to mind. They are of an oblong oval shape, tapering slightly towards one end, and measure, one .90 of an inch in length by .62 in breadth, the other .90 by .70 of an inch. Their ground color is a dull white, slightly tinged with green, and strongly marked over the entire egg with small, but distinct spots of a dark purplish brown, so dark as to be only distinguishable from black in a strong light. Interspersed with these markings are other fine dottings, less distinct and of a lighter shade, and of a dark slate color, with a slight reflection of lilac. The nest and eggs closely correspond with a nest and its contents, taken by Dr. Cooper.

Carpodacus cassinii.

A nest with four eggs of this bird was taken May 31st. It was built in a cactus. These somewhat resemble the eggs of the common *C. purpureus*, but are smaller. They have a ground of a light bluish green, and are marked with a few blackish, or dark brown, spots about the larger end. They have an oval shape, and measure .80 of an inch in length by .56 in breadth.

Peucæa capalis (Coues).

This is a new species discovered by Capt. Bendire, in Arizona, and described by Dr. Coues. The nest, containing four eggs, was found Sept. 11th, 1872. It was built in a small mesquite tree, four or five feet from the ground. The eggs, like all the others of this genus, so far as known, are pure white, with the slightest tinge of blue, are nearly globular in shape, measuring .70 of an inch by .60.

Pipilo mesoleucus.

One nest of this species was found August 2d, another September 4th, 1872. They were both built in mesquite trees, and were at least six feet from the ground. The position of the nest is peculiar in one of this family, which is almost always to be found on the ground, and the eggs are much more aberrant in their peculiarities, differing in a very marked manner from those of all other species of *Pipilo*, and having much greater affinities with the eggs of the *sturnellæ*, especially with those of the South American *militaris*. The eggs of one set measure one inch in length by .73 of an inch in breadth, have a bright white ground, in which there is just a touch of bluish, and are boldly plashed, especially around the larger end, with distinct deep dashes of reddish and purplish brown. A few of these blotches are scattered irregularly over the entire egg, but the greater portion are grouped around the more obtuse ends. The eggs are oval in shape, with both ends rounded, but one is smaller than the other. In the other set the eggs are more nearly spherical, and with less difference between the two ends; the ground color is more distinctly white, the spots of reddish brown are finer and more concentrated around the larger end, and the faint markings of purple are much more numerous. These measure .90 by .74 of an inch.

Pipilo aberti.

This species of *Pipilo* was also found by Capt. Bendire breeding, not on the ground, but in trees and bushes at the height of several feet. One nest was found July 28th, in a small ash tree; another was found on the same day in a willow, and eight feet from the ground. They bear a very close resemblance to the eggs of *Pipilo fuscus*, and to those of *P. albigula*, having a ground color of a very light blue, marked almost exclusively around the larger end with a wreath of irregular dashes of dark purplish brown. They are of a rounded oval shape, obtuse at one end, and vary in length from .97 of an inch to .88, and in breadth from .76 to .75.

Lophortyx gambelli.

This bird was found breeding by Capt. Bendire, in the vicinity of Reledo Creek, Arizona, and in some instances nesting in situations above the ground. One nest, found June 7th, 1872, containing three fresh eggs, was placed two feet above the ground, on a willow stump, and in an exposed place near the creek. The nest was composed of the leaves of the cotton-wood tree. In some instances he found as many as eighteen eggs in a nest. The eggs closely resemble those of the Californian quail, and might readily be mistaken for them. They are of a rounded oval shape, sharply tapering at one end, and quite obtuse at the other, and measure 1.24 inches in length by one inch in their largest breadth. Their ground varies from a deep cream to a light drab color. Some are marked with large and well defined spots, most of them circular in shape, of a rich purplish brown. In others the whole surface is closely sprinkled with minute spots of yellowish brown, intermingled with which are larger spottings of dark purple.

Section of Entomology. May 28, 1873.

Mr. J. H. Emerton in the chair. Nine persons present.

The following communication from Dr. A. S. Packard, Jr., was read: —

OCCURRENCE OF RARE AND NEW MYRIAPODS IN MASSACHUSETTS.

For nearly two years we have had in the Museum of the Peabody Academy of Science a specimen of *Scolopendrella*, detected Sept. 8, by Mr. C. A. Walker, under a board in the grounds of the Museum. It is nearly related to *Scolopendrella immaculata* Newport, and if new may be called *S. Americana.* Of the remarkable features in the structure of this animal I do not now propose to speak. It has, however, in the head and antennæ a strong resemblance to Campodea, and in this and in the presence of spines at the base of the legs, and in other characters, it bears a striking similarity to the Campodeæ and the Thysanura, as already indicated by Lubbock. It may be regarded as a connecting link between the Thysanura and Myriapoda, and shows the intimate relation of the Myriapods and the Hexapods, perhaps not sufficiently appreciated by many zoologists.

Another Myriapod of much interest, which is not uncommon in Massachusetts, but not mentioned by Prof. H. C. Wood, Jr., in his work on this group, is the *Polyxenus fasciculatus* Say. It has not been noticed apparently since the time of Say, except in the third edition of the "Guide to the Study of Insects" (1872), where it is stated that Mr. F. G. Sanborn has detected it under the bark of trees near Boston, and that subsequently it was found by myself in the same situation at Salem and Nantucket.

Mr. S. H. Scudder exhibited a portrait of Abbot, the author of the "History of some of the rarer Lepidopterous Insects of Georgia." This portrait is a copy of one contained among Abbot's original drawings in the British Museum.

Mr. Scudder explained the object of a collection of orthopterological illustrations, prepared by placing upon separate sheets of uniform size figures cut from plates. The whole can be arranged in systematic order, as in a card catalogue, and is very convenient for classification and reference.

Mr. Scudder also exhibited a figure of an English fossil insect which had been described as Lepidopterous, and as one of the *Satyridæ.* The original specimen belongs to Mr. Charlesworth, and the reverse to the Jermyn St. Museum. The neuration seems impossible for a Lepidopterous insect, and resembles that of the *Cicadæ* more nearly than anything else, but differs in the nervures at the base. In Mr. Brodie's collection Mr. Scudder found pupæ of *Cicadinæ*, which correspond to this insect in size, and are found at the same, or nearly the same, geological horizon.

June 4, 1873.

The President in the chair. Sixteen persons present.

Dr. Thos. Dwight, Jr., showed a seventh cervical vertebra of a woman, in which a rib took the place of the lower transverse process. He also exhibited a fœtal porpoise, one side of which was dissected in order to show the skeleton *in situ.*

The thanks of the Society were voted to Messrs. F. G. Frothingham and P. T. Barnum, and to Mrs. R. C. Greenleaf, Jr., for donations to the Museum.

June 18, 1873.

The President in the chair. Eighteen persons present.

Prof. E. S. Morse read a paper on the "Embryology of Terebratulina," which will appear in the Society's Memoirs.

Dr. Dwight made some remarks on the action of the intercostal muscles.[1] From a careful study of the subject he had concluded: — first, that the action of the intercostals during ordinary respiration is very slight, if, indeed, there be any other than ligamentous; second, that both sets of muscles at the upper part of the chest tend to raise the ribs; third, that owing to the fixing or drawing down of the lower rib, both sets in the lower part of the chest may tend to draw the ribs downward; fourth, that by sudden contraction, drawing the ribs together, they are muscles of spasmodic expiration; fifth, that position, muscular action, disease, deformity, and various slight indefinable causes may modify the action of any part of them.

Mr. Bouvé, in behalf of the committee on the Walker Prizes, reported the award of a First Prize (sixty dollars) to Dr. A. S. Packard, Jr., for an essay on the Development and Transformations of the Common House Fly.

October 1, 1873.

The President in the chair. Eighteen persons present.

Capt. Charles Bendire, U. S. A., was elected a Corresponding Member, and Messrs. T. F. Ham, T. Sterry Hunt, Chas. A. Richards, R. S. Warren and S. W. Winslow were elected Resident Members of the Society.

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[1] For a full exposition of this subject, see the Boston Medical and Surgical Journal, June 8, 1873.

Mr. F. W. Putnam described the structure of the sucker in the fishes belonging to the family Liparidæ. Mr. Putnam also said that Dr. Packard had recently dredged in Salem Harbor a species of Liparis new to the Massachusetts fauna, the *L. lineatus* or *vulgaris*, of Europe. The *L. Montaguii* has also been found in our bay, and we thus have two species of the genus common to both Massachusetts and Europe.

The donation of a large and very valuable series of fossils, obtained by Prof. Hyatt in Europe, and presented to the Society through the liberality of John Cummings, Esq., was announced.

October 15, 1873.

The President in the chair. Eighty-one persons present.

Mr. S. H. Scudder described a cat and kittens which he had seen at Plymouth, N. H., supposed to be a cross between the rabbit and the cat. The animals had a short rabbit-like tail, long haunches, and a rabbit's gait, but in other respects were feline. The owners of the three specimens were all earnest in their declaration of the rabbit-cat ancestry of their pets. Mr. Scudder could not believe in the possibility of a cross between animals so far apart in the natural system, and asked for information from those present.

Mr. R. Bliss, Jr., said he had seen similar cats, for which a like pedigree was claimed, in Middleton, Ct.

Mr. F. W. Putnam thought a cross between two animals belonging to two different orders, the carnivora and rodentia, impossible, and that the case would no doubt turn out to be the same as with the racoon cat, which had been discussed in the "American Naturalist". He believed such forms to be accidental monstrosities, like the famous *Ancon sheep*.

Dr. Brewer made some remarks on the Hermit Thrushes, under which name he designated those species of Turdus belonging to the subgenus Hylocichla.

Eight species of the group were recognized by the speaker: — *mustelinus*, *pallasi*, *nanus*, *auduboni* (= *silens* of Swainson), *fuscescens*, *swainsoni*, *ustulatus* and *aliciæ*. Prof. Baird, however, would admit only five of these forms to specific rank, uniting *nanus* and *auduboni* with *pallasi*, and *swainsoni* with *ustulatus*; and with these two last Mr. Allen also joins *aliciæ*. Dr. Brewer could not believe in the propriety of these views. *Turdus aliciæ*, he said, differs from *T. swainsoni* in coloration, size, time of migrations, song, distribution in the breeding season, and in the nests and eggs. *T. ustulatus* has more claim to be considered a western race of *swainsoni*, but there are constant differences in habits as well as in plumage, which he thought entitle it to be treated as specifically different.

The same is also the case with *nanus*, and with *auduboni*. He was also still inclined to regard these as sufficiently distinct from *pallasi* to be regarded as separate species; especially as from the general law of size in northern and southern varieties of one species, we expect the southern forms to be smaller than the northern, and, therefore, if *T. nanus* is a race of *pallasi*, being the northern race, it should be larger instead of smaller. If Dr. Cooper's account of its nesting and eggs is correct, we have still stronger reasons for its specific rank. Prof. Baird, however, conjectures that Dr. Cooper was mistaken, and that the nests, supposed by him to be those of *T. nanus*, really belonged to *T. ustulatus*, and this conjecture is partially confirmed by the fact that skins from Dr. Cooper referred to *T. nanus*, prove to be actually skins of *T. ustulatus*.

In regard to *T. auduboni*, we meet again this anomaly. To be a race of *T. pallasi* this bird, being a southern resident, ought to be, by the law just referred to, a smaller bird than *T. pallasi*; instead of which it is larger. *T. pallasi* is a ground-builder, never known to build anywhere else. The only nest of *T. auduboni* ever found was built in a tree. Then again, *T. auduboni* is a constant resident all the year of the temperate regions of Vera Cruz, where *T. pallasi* is only a resident in the winter months.

Dr. T. Sterry Hunt gave some account of the crystalline rocks of the Blue Ridge, and their decomposed condition, as seen by him at various points in the region to the southwest of Lynchburg, Va.

They are principally gneisses with hornblendic and micaceous schists, like those of the Montalban or White Mountain series, and are completely decomposed to a depth of fifty feet or more from the surface, being changed into an unctuous reddish brick-clay, in the midst of which the interbedded layers of quartz are seen retaining their original positions, and showing the highly inclined attitude of the strata. In the adit of a mine, where the rocks had been penetrated to a considerable distance, the coarsely feldspathic gneiss was found completely kaolinized, but free from the ferruginous coloring of the surface, while farther in, after passing through a partially decomposed portion, the hard unchanged rocks were met with. A similar decomposition of the gneissic and granitic rocks in Brazil, extending to a depth of one hundred feet, has been well described by Hartt, and is known in many other regions. The speaker noticed the permeable nature of the surface-soil thus formed of inclined clayey strata, which affords a natural subterranean drainage, and prevents the accumulation of water in pools and lakes.

The nature of these chemical changes of the gneissic and hornblendic rocks was next considered. It consisted essentially in the removal, in the form of soluble carbonates, of the alkalies, lime and magnesia of the silicated minerals, and the hydratation of the residues. The iron-oxyd from these has also been in great part dissolved out by subsequent processes, and was the source of the immense deposits of hydrous iron ores which are found at the foot of the barrier range of the Blue Ridge throughout the Appalachian valley.

The great antiquity of this chemical decomposition of the rocks was next alluded to. It was, in his opinion, effected at a time when a highly carbonated atmosphere, and a climate very different from our own, prevailed. That this decomposition had extended to the crystalline rocks to the northeastward, he did not doubt; and he ascribed the absence of decomposed rocks in these regions to a process of denudation during successive ages, which culminated at the time of the submergence of the northeastern Appalachians at the end of the pliocene period, when the remaining softened material was swept away by the action of water and ice, and the hard, unchanged rocks beneath were exposed and glaciated; since which time the chemical decomposition of the surface has been insignificant.

As we proceed southwestward from New York, we find that the partially decomposed and disintegrating portion of these rocks which, in the Blue Ridge, lies beneath the clays, has escaped denudation, and we at length reach the region in southern Virginia and Carolina, where these clays, the result of complete decomposition, are seen in nearly vertical strata forming the superficial soil. These ancient clays, formed by the sub-aerial decay of the crystalline feldspathic and hornblendic rocks of the great eozoic continental areas, were, according to the speaker, the source of the argillaceous strata of the cenozoic, mesozoic and paleozoic periods; and in the heights of the southern Appalachians we have still remaining a portion of that eozoic land which has stood throughout all these ages, undenuded, unglaciated, unsubmerged, and from its peculiar nature (being composed, as already described, of highly inclined porous and permeable strata, supporting an abundant vegetation), but little subject to the degrading influences of atmospheric waters.

Mr. S. H. Scudder exhibited a very valuable collection of the original and unpublished drawings of John Abbot, illustrating the transformations of our southern Lepidoptera, and supplementary to Smith & Abbot's magnificent "Insects of Georgia." Mr. Scudder hoped to purchase the collection for the library of the Society by subscription.

Section of Entomology. Oct. 22, 1873.

Mr. S. H. Scudder in the chair. Twelve persons present.

Mr. Scudder called the attention of the Section to some recent remarks by Mr. Meldola[1] upon *Iphiclides Ajax* (*Papilio Ajax* Auct.).

These remarks were made in connection with investigations "on the amount of substance-waste undergone by insects in the pupal state"; it was presumed *a priori* that, as there was gain of matter in the larval state, and loss during the pupal, the size of an individual of any species "would be, *cœteris paribus*, inversely proportional to the ratio of the pupal to the larval period, or directly proportional to the ratio of the larval to the pupal period."

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[1] Ann. and Mag. Nat. Hist., XII, (Oct., 1873), p. 301-307.

Mr. Meldola attempted to test this theory by tabulating the statements of Mr. Edwards concerning the duration of the stages in the different polymorphic forms of Ajax, and he found "that there was a relationship, but exactly the reverse of that which would be anticipated from the conclusions previously set forth."

The three forms of Ajax have been called by Mr. Edwards *Walshii*, *Telamonides* and *Marcellus*, and these increase in size in regular ratio and succeed each other in season in this order; the following table represents the duration of the several stages, and is taken by Mr. Meldola from Mr. Edwards' work: —

	Eggs.	Larva.	Chrysalis.	Total.
Walshii.	7–8 days.	22–29 days.	14 days.	43–51 days.
Telamonides.	4–5 "	15–18 "	11–14 "	30–36 "
Marcellus.	4–5 "	12–19 "	11–14 "	27–38 "

The next table is Mr. Meldola's attempted tabulation of the facts by which he comes to the above conclusion : —

Name of variety.	Ratio of mean pupal to mean larval period.	Ratio of mean larval to mean pupal period.	Mean expanse ♂.
Walshii.	$\frac{14}{25\cdot5} = 0.549$	$\frac{25\cdot5}{14} = 1.821$	2.70
Telamonides.	$\frac{12\cdot5}{16\cdot5} = 0.757$	$\frac{16\cdot5}{12\cdot5} = 1.320$	3.00
Marcellus.	$\frac{12\cdot5}{15\cdot5} = 0.806$	$\frac{15\cdot5}{12\cdot5} = 1.240$	3.35

"It is here seen," says Mr. Meldola, "that the size of the variety is directly instead of inversely proportional to the ratio of the pupal to the larval period, and *vice versa*." Unfortunately for this conclusion, the figures given by Mr. Edwards, or their reduction by Mr. Meldola, refer in each case to the *progeny* of *Walshii*, *Telamonides* and *Marcellus*, and do not bear upon the question; in every instance given in the tables the progeny or resultant is *Marcellus*; *Walshii* and *Telamonides* are the produce of wintering Chrysalides, and therefore by Mr. Meldola's rule, should be, as they are, smaller than *Marcellus*, which, on the other hand, is always the result of short lived summering chrysalids; unless, however, some unknown factor plays a part, *Telamonides* should be smaller than *Walshii*, because produced later in the season, from wintering chrysalids; but here the opposite is the truth.

Mr. Scudder further observed that Mr. Edwards had not drawn attention to the fact that *Walshii* and *Telamonides* belonged to the same brood; the former consists of earlier, the latter of later individuals from wintering chrysalids; the second brood of the species (the first from short lived chrysalids) is *Marcellus*, and made up of the mingled progeny of both *Walshii* and *Telamonides.*

Mr. E. P. Austin said that during an excursion of the Section to Cliftondale, Mass., he had taken about one hundred and ten species of Coleoptera, including some rare species, which have been abundant during the past season.

Mr. Austin also exhibited a collection of Coleoptera taken on Mt. Washington from the 19th to the 29th of last July, including about 225 species, quite a number of which are new.

Mr. Scudder stated that he had found the larva of *Œneis semidea* feeding on Carex by night, as Mr. Sanborn had also done in the day time. His former supposition that this larva feeds on lichens[1] must be abandoned. He had attempted to obtain the eggs of this species by confining gravid females with their food plant, but succeeded in obtaining only one unfertile egg; he had also once succeeded in securing a single egg of the European *Œneis Aello* from a female shut in a pill box, and found that the insect hibernated immediately after leaving the egg.

November 5, 1873.

The President in the chair. Sixty-one persons present.

The following papers were read:—

STRUCTURE AND ACTION OF STRIATED MUSCULAR FIBRE.

BY THOMAS DWIGHT, JR., M.D.

It would be alike tedious and superfluous to attempt to recapitulate the various views held on this subject, not only because this has been repeatedly done, but also because most of the methods employed have been so unsatisfactory as to throw doubt on the conclusions.

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[1] Boston Journ. Nat. Hist., VII, 625.

Fibres have been used after removal from the body, teased out by needles, or flattened by the covering glass, and further affected by the abnormal media (among which even air is to be reckoned) in which they were examined. The contractions occurring under these circumstances are irregular, and mostly short-lived. Another very important objection appears to have escaped attention, namely: that when a muscular fibre is removed from the body it has lost its attachments, and owing to its properties of tonicity and elasticity it must, either at rest or in action, be in different relations from those of the living fibre. Merkel[1] states frankly that he never has been able to follow the steps of contraction. He could see the fibre begin to move, the movement become quicker, and then the contraction would be complete without his having been able to see the intermediate phenomena. He contrived to obtain permanent views of more or less contracted fibres by throwing small parts of living animals into absolute alcohol, which struck the fibres dead in all the stages of vital action, but he has disregarded the chances of error from the specific action of the reagent on the substance of the fibres, and on their last movements. Wagener and Engelmann appear to have made some observations on living animals, or on parts of them, but I have seen no detailed account of these studies, and cannot think that they carried them far, for had they done so they certainly would not have relinquished them.

After studying fibres pulled from the legs of flies and grasshoppers, I turned my attention to water beetles, and accidentally discovered that the legs of several of the smaller kinds were sufficiently transparent to give a good view of the muscles *in situ*, but that the genus *Gyrinus* is far superior to any other. The method is very simple: a leg of either the middle or hind pair is cut off, between the coxa and trochanter if possible, and put on a slide in a drop of water under a very thin covering glass. Care should be taken to have the leg tolerably straight, for if much flexed some of the best parts are obscured. The muscles are here in an almost perfectly normal condition, for their attachments are uninjured, and the water in which the leg is placed (its native element, by the way) can hardly penetrate beyond the joint below the point of division. The only disadvantage is that the specimen is cut off from its nutrient and nervous supplies. A successful experiment affords one of the most striking views in the range of microscopy; the muscular fibres of apparently semi-fluid consistency are in almost constant, though irregular, motion, carrying the smaller branches of the tracheæ to and fro, as seaweed is swung by a wave. These phenomena sometimes continue for an hour and a half, with no other encouragement than an occasional slight tap on the covering glass. The following observations have been made on the trochanter, the femur and the tibia. In the two former it is easier to find places where there is but one layer of fibres, but the tibia is usually preferable, for the shell is more transparent, and there are many fibres attached at different degrees of obliquity to a tendon, so as to illustrate the effect of more or less tension. Moreover, these fibres, owing perhaps to the proximity of a large tracheal dilatation, preserve their irritability much longer than others.

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[1] Archiv für Mikroskopische Anatomie, Band VIII, Heft 2.

The work of which this paper contains the results, has been done entirely on preparations of this kind of the legs of the *Gyrinus.* The observations were made while the fibres were still capable of contraction. Hartnack's immersion objectives, Nos. 9 and 10 (usually the latter) were employed, with his No. 3 ocular, and the draw-tube drawn out.

As is well known, the muscular fibres of insects are not bound to gether by interstitial tissue nearly so strongly as those of vertebrates, and each is able to contract freely independently of its neighbors. The states in which muscular fibre is seen may be divided into four chief ones.

The *first state* (Plate II, fig. 1 and fig. 2, *A*) is the essentially normal one in which the fibre is at rest, but extended between points far enough apart, and sufficiently fixed, to oppose a certain resistance to its elasticity and contractility.

The *second state* (fig. 3) is seen when the fibre is free from all strain or resistance; it is that which a fibre in the first state would assume if one of its attachments were divided, or moved much nearer to the other.

The *third state* (fig. 2, *C*), usually owing to contraction of another part, is one in which a part of a fibre is put upon a decided stretch.

The *fourth state* (fig. 2, *B*) comprises all the degrees of active contraction.

In the *first* state the borders of the fibre are straight, and are connected by narrow transverse bands of a black granular structure, which present considerable variation. Usually the minute black granules lie so near together that no other substance is visible between them, but sometimes they are separated into two distinct lines in a transparent ground substance, and again they may be so close together as to give the band an almost homogeneous appearance. On each side of these bands is a glaring white one, usually broader on one side than on the other. As the stage is rotated the brighter band pales, and the dimmer one brightens, while minute changes in the adjustment or illumination produce similar almost indescribable effects.[1] The bright bands are connected by a broad gray stripe, which is midway between two black bands. I have never seen a lighter stripe in the middle of the gray one in muscle inside the body, but can fully confirm the common account of it in fibres pulled from the leg of the fly. To recapitulate; a fibre at rest consists of a series of gray stripes with white borders situated between black granular bands.

The *second* state is best studied on fibres running to the lower part of the tendon that passes from the tibia to the end of the limb, for in many positions of the leg they are completely relaxed, and hang in graceful curves. When, as sometimes happens, the tendon is broken, they are seen to particular advantage. The whole fibre is broader than in the first state. The black bands are usually somewhat narrowed, and also drawn nearer together. Their granular nature can almost always be made out, but the granules are never seen in two rows. The white and gray stripes are both visible, but are narrower, especially the former, than in the normal condition. The edges of the fibre are scalloped. The ends of each projection come into the borders of the black bands, the greatest bulging being opposite to the middle of the gray.

In the *third*, or stretched condition, the fibre is decidedly narrower, with a peculiarly sharply defined outline. The granular bands are pulled apart into two parallel lines of dots lying in a brilliant clear ground, which is continued into the two white bands. The gray band is lighter, and the bright bands darker than when at rest, so that all parts of the ground substance present nearly, though not quite, the same appearance.[2] The appearances of contracted fibre will be best described in connection with the accompanying phenomena.

On looking at the tibia or femur when the fibres are in active contraction, the attention is constantly distracted by the strangeness of the view, and by the multiplicity and rapidity of the changes in progress. It requires much practice and the closest attention, to fix the eye on a part of a fibre at rest, and to keep it there so as to note the successive changes. If the contraction be very rapid it is probably impossible to do so, but when it is becoming weaker it can be done very fairly; but I must admit that I have not been able to satisfy myself positively on certain points to be presently noticed. This much, however, is certain, namely, that with experience it is easy to follow an individual black band from the state of rest to that of full contraction, which shows that the homogeneous stage (Zwischenstadium), supposed by Merkel to occur in partial contraction, has no existence, and that his theory of an exchange of places between two substances in closed cases is impossible. The general impression given by a wave of contraction is that a part of the fibre dilates, that the black bands become more prominent and, while approaching each other, run with the wave along the fibre. This last appearance is partly true and partly deceptive, for to be drawn together the bands must really move; but the effect is exaggerated by new parts in front of the wave, entering into contraction as those behind it are relaxed. The substance between the black bands is evidently the contractile element. Two or three bands are seen to be drawn quickly nearer together, and the gray substance between them disappears, so that there is an alternation of black and white stripes. This first step of contraction occurs so rapidly that the observer is scarcely aware of it before it is completed, but as the wave runs along the fibre it is more easily observed. The black bands can be seen to approach one another, and sometimes even the granules composing them to get nearer together; in full contraction they are sometimes apparently homogeneous, sometimes granular, but it is important to notice that their edges are rarely sharply defined against the white; they appear irregular and granular. The borders of the fibre are so frequently seen to become scalloped, that I cannot but think it the universal law, though often, owing to the proximity of other fibres, the swellings cannot be seen. At the point of greatest contraction the fibre is much broader than elsewhere, and there is no doubt that the black bands are lengthened; nevertheless they appear longer than they really are, for the bulgings at the ends of the light bands come so near together that they almost touch one another, and their edges being rendered indistinct by optical effects appear, in part, as prolongations of the black bands.

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[1] *Vide* Heppner in Archiv für Mikroskopische Anatomie, Band v, Heft 1.

[2] In fig. 2, *C*, the difference between the gray and white is too marked.

The most puzzling point of all is to decide at just what stage of contraction the gray disappears. This is particularly difficult to observe, because the colors are changing their shades and positions at the same time. It is certain that the gray has disappeared somewhat early in the contraction — say in its first half, and also that it is not the very first change, for it may be seen in very slightly contracted fibres. There does not appear, at least in the detached leg, to be any law regulating the direction of the wave; it seems quite accidental whether it runs toward the tendon or from it. Usually it begins at one end of a fibre, and after a moment's pause runs the whole length, when it either dies out, or, as is more frequently the case, returns, gradually growing weaker, and embracing less of the fibre. When the specimen is fresh and lively, a wave of average size comprises the substance between seven or eight bands, and as long as contraction lasts, rarely less than that of three elements is involved. As the wave runs toward the end of a fibre the part behind it is put more or less upon the stretch, frequently enough so for it to assume the condition already described as the third state. When the contraction is nearly over, it is not rare to see the fibre restored to its normal state by a sudden jerk in the direction opposite to that pursued by the wave, evidently caused by the elasticity of the stretched portion. The contractile force of the part of fibre in action overcomes the elasticity of the part at rest, but at a certain moment the latter property reasserts itself.

Merkel, as already mentioned, describes a homogeneous appearance as characteristic of a certain stage of contraction. Schäfer, on the other hand, thinks it occurs during perfect rest. For my part I have never seen it at all. In beetles, however, that have suffered from confinement, it is not very rare to find the markings very indistinct, and in some cases many stray granules are found in the fibre, particularly near the surface. I have often noticed the latter appearance after the muscle had become exhausted by electricity. The long muscle corpuscles, well described and represented by Klein,[1] are often seen very near the surface of the fibre. In the living and healthy muscle a longitudinal striation is almost never seen, though it appears in unhealthy fibres. It is superficial, and probably exists solely in the sarcolemma.

The polariscope has been much used, in order to decide on the differences of the nature of certain parts, but the results of different observers are not in harmony, and it may well be questioned whether results obtained by its use on fibres hardened by reagents, are of any particular value. In the case of the entire leg, it proved unavailable, for the presence of two layers of shell, enclosing often more than one layer of muscle, rendered the few results which I obtained quite untrustworthy. It has been stated that the staining qualities of hæmatoxylin make it a substitute for polarized light; accordingly I repeatedly put a living beetle into a pretty strong solution; but though I once left one in for twenty-four hours, during the greater part of which time life was extinct, the tissues showed that none of the coloring matter had passed the skin, so that I was obliged unwillingly to give up this class of experiments.

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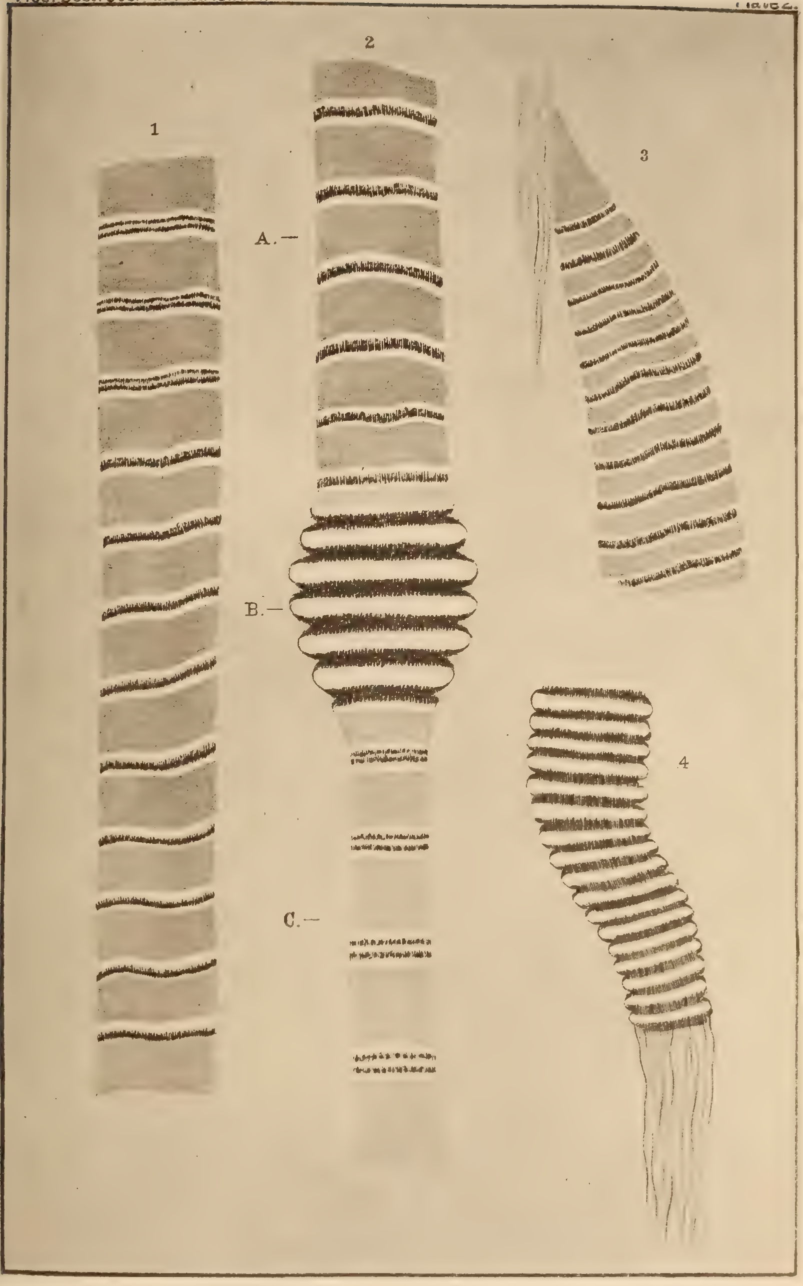
[1] Handbook for the Physiological Laboratory.

By the kindness of Professor Henry P. Bowditch, I was enabled to perform in his laboratory a series of electrical experiments with both the constant and the interrupted current. The effect of a single shock, or of the use for a short time (say a minute) of a weak interrupted current, was to produce lively, though irregular action; the waves ran in both directions simultaneously. If a strong interrupted current were used, or a weak one were long continued, the muscle became tetanized; the waves of contraction ceased, and whole fibres assumed the appearances of the extremest contraction throughout; nothing could be seen but a succession of very narrow black and white lines. The experiments with the constant current promised to be of great interest, but as they were very difficult, and threatened to lead me far beyond my original plan, I soon decided to leave them for abler hands.

Let us now glance at the difference of the results obtained by this method, and by examining fibres taken from the legs of the large water beetles, Hydrophilus and Dytiscus. For the appearances of those of the Hydrophilus, I have used Heppner's plates (*loc. cit.*), and for those of the Dytiscus, original observations on fibres from the leg without any reagent. The muscles of the two are precisely similar. By comparison with those of the little Gyrinus, *in situ*, it appeared that the fibres of the larger beetles were much broader, but that the stripes were in proportion much nearer together. To see if this did not depend on the abnormal condition of the larger fibres, I endeavored to obtain fibres from the Gyrinus. There was little difficulty in doing this if a leg, or a part of the abdomen, were broken to pieces in a drop of fluid, but unfortunately it was almost impossible to separate the muscles from the shell without such addition, and when a minute piece was fortunately isolated, it, as a rule, immediately became dry and useless. Fig. 4, Pl. II., represents a fibre teased out in glycerine; it shows that the black stripes are strongly drawn together, that their granular structure is indistinct, and that the gray bands are wanting. It is more or less obscured by the longitudinal folds of the sarcolemma which give it a somewhat fibrillated appearance. The particular fibre chosen is not an extreme case; on the contrary, most fibres were much more obscure, and those in water more contracted than those in glycerine. In the few specimens of any value to which no fluid had been added, most of the fibres were less normal than the one drawn, and I can remember but two individual fibres that were decidedly more so. There can be little doubt that if it were possible to examine the fibres of the larger water beetles, *in situ*, that they would present quite different proportions from those usually ascribed to them.

The following are briefly the conclusions which the preceding observations appear to warrant. The fibre consists of a sheath, the sarcolemma, and of a ground substance, in which elements which may provisionally be called granules, are imbedded in transverse double rows. There is no reason to suppose that the difference between the white and the gray has any other than an optical cause, namely: that the part of the ground substance nearest the black bands receives not only the rays of light that would naturally strike it, but others reflected or refracted, or both, from the black bands, and which do not strike the middle of the space between the latter. (Heppner, Schäfer.) If this be admitted, it is merely a corollary that, in contraction, the gray should disappear; as is the case. No appearances have been seen that are suggestive of the handles of Schäfer's dumbbell-like rods, which, indeed (judging from the abstract of his paper), he has assumed rather than demonstrated. As has been already stated, nothing like fibrillar structure is to be seen in the living and healthy fibre.

The sarcolemma is firmly attached to each edge of the ends of the black bands, and the granules must, in some way, be prevented from separating laterally, so as to give the support for the folds, into which the muscle contracts. The ground substance is the contractile element; it is also highly elastic. When the fibre is stretched all parts become narrower, and when contracted, broader; but in the latter case the change is chiefly in the ground substance.



Dr. H. P. Quincy, Del. Heliotype.

DWIGHT, STRUCTURE OF MUSCULAR FIBRE.

EXPLANATION OF PLATE II.

The drawings are all from fibres of the *Gyrinus*, as seen with objective 10 immersion, and No. 3 eyepiece (Hartnack), and are slightly reduced.

Fig. 1. Muscular fibre at rest under normal conditions, showing the various appearances of the granular and bright bands.

Fig. 2. A fibre at rest at *A*, contracted at *B*, and stretched at *C*.

Fig. 3. A fibre in passive contraction (second state) attached to a tendon.

Fig. 4. A fibre teased out in glycerine.

The drawings are more or less diagramatic, owing to the great difficulties which the object presents. This is particularly the case at *B*, in fig. 2, and can easily be accounted for when it is remembered that the wave of contraction is never stationary for a second. The gray at *C*, in fig. 2, is too dark.

Notes on the Genus Myxine. By F. W. Putnam.

The specimens which I have the pleasure of bringing before the Society to-night belong to a most interesting genus of fishes, and are the second stage in the development of the great branch of the animal kingdom which reaches its culmination in man. The only lower form of vertebrates known is the single species, which has the characteristics of a vertebrate animal of such an elementary structure, or entirely suppressed, as to induce Professor Haeckel to separate it from all other vertebrates as a primary division of the branch under the name of Leptocardia.

In the animals before us we find a most lowly organization, but still everything in their structure is markedly of the vertebrate type, and no one can hesitate as to their position in the system being above the lancelet, and below the lampreys.

As my object to-night is not to dwell upon the details of the anatomy of the subclass of *Cyclostomata*,[1] which includes the families of *Petromyzontidæ* and *Myxinidæ*, and is fully given in the works of Müller, Owen, Huxley, Günther, and other authors, I will simply call attention to some points in the anatomy of the specimens of *Myxine* before us. The body is eel-shaped, and is covered by a thin skin, which is easily detached. Along the under side, for very nearly the whole length of the animal, are two rows of mucous glands, each gland having an external opening, and from these, during life, there is exuded a mass of mucus that renders these, of all animals, the most slimy. There are no eyes.[1] The brain is small, but of the normal fish type, and without special development of its parts. There are no pectoral or ventral fins, or any internal structure corresponding to the bones of the pectoral arch, or to the pelvis. The median fins are developed, and the united dorsal, caudal, and anal fins are supported by fine cartilaginous rays. The skull is but slightly developed as a cartilaginous box, and the flexible notochord enclosed in its sheath, and extending from the base of the skull to the end of the tail, is all there is to represent a spinal column. There are no jaws, and the mouth is round and suctorial, without lips, and provided with a pair of barbels on the right and left sides. At the very extremity of the head, on the median line above, is a single nasal aperture, which is provided with two pair of barbels, and opens into the upper part of the mouth. This large nasal cavity is furnished with nerve fibres from the broad fringes of the olfactory nerves, which penetrate it from behind, and it is evidently a very important organ; smell being the most developed sense of this low animal. The teeth consist of a single median one on the roof of the mouth, and two rows on each side of the tongue, which is a powerful organ, with a strong fibrous tendon moving in a muscular sheath. With the exception of a slight contraction at a point opposite the heart, the alimentary canal is a simple straight tube to the anal opening, which is not far from the end of the tail. The liver is large, and consists of a broad, thick and short right lobe, which encloses the pericardium with its broad, forward portion, and folds over the intestinal canal; the left lobe is but slightly connected with the right, and holds a median position below it, enclosing the intestinal canal on its inner surface. The gall bladder is relatively large, and placed between the lobes of the liver. The heart is small, of the usual form in fishes, and is enclosed in a pericardium. The cardiac aorta is proportionally large, and gives off its branches alternately to the six branchial sacs on each side. The branchial sacs are placed on each side of the œsophagus, lying directly against its outer walls, and the water passes into them by a small pore opening directly from the œsophagus into each sac; it is then passed out by a duct,[1] which continues backwards along the outer walls of the sacs to the abdominal wall at the end of the last sac, where all the ducts from one side unite in one,[2] and the water is emptied at the branchial opening on each side of the median line. In close connection with the branchial opening on the left side, there is a third opening[3] that leads by a very short duct to the œsophagus, and may be the means of allowing water to pass directly into the œsophagus, and hence into the branchial sacs, at times when the supply through the mouth is cut off by the head being buried in the food of the animal. The kidneys are long tubes situated on the median line of the dorsal part of the abdominal cavity. The ovary is single, and is situated on the right side of the intestinal canal. In specimens where the ovary is not developed, it is seen as a simple white membrane lying on the outer wall of the whole length of the intestine, in close connection with the great mesenteric vein, which is unusually large. As the eggs are developed the ovary is stretched out, the eggs forming a fringe at its free edge. There are no oviducts; the eggs when mature break from their ovarian capsules, and falling into the abdominal cavity are excluded through the peritoneal opening at the side of the anal opening.

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[1] Also known under the names Marsipobranchii and Myzontes. The lancelet is excluded, for from our present ideas of the limits of groups I am inclined to regard this single species as representing the lowest subclass of vertebrates, the Leptocardii.

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[1] Owen describes the organ of sight in the Lancelet and Myxine as "a minute tegumentary follicle coated by dark pigment, which receives the end of a special cerebral nerve."

With this hasty description of the general anatomy of the fishes before us, I will proceed to the special subject of my communication, which is to show that though the geographical distribution of the group is very extended, we can recognize but a single species in the genus.

The material which I have been able to use for this purpose is quite extensive, and consists of a fresh specimen dredged by Messrs. Packard and Cooke off our eastern coast in September last, and several specimens in the Museum of the Peabody Academy of Science, which were presented by Prof. Agassiz to the Essex Institute in 1858, and were collected at Grand Menan by Mr. J. C. Mills, during the season of 1857. By the kindness of Prof. Agassiz, I have also had the opportunity of making a careful study of a large number of other specimens collected by Mr. Mills at the same time with those mentioned above; also three specimens received from Liverpool by the Museum of Comparative Zoology, which were collected on the English coast. But the most important material, for which I am also indebted to Prof. Agassiz, is the large collection of over two hundred specimens of young and old, collected by the Hassler Expedition in the Straits of Magellan, during the month of March, 1872. I have thus been able to compare undoubted specimens of the *Myxine glutinosa* from the northern European waters, with specimens from our own northeastern coast, and with specimens from the southern part of South America; the latter being unquestionably identical with those described by Jenyns under the name of *M. australis.*

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[1] The figure given by Home, and copied by Owen and other authors, does not correctly show the course of these branchial ducts, as they are represented as short ducts leading directly into one long tube that passes along the outer walls of the sacs to the branchial opening.

[2] Müller's figure represents the ducts as here described.

[3] The figure mentioned in the preceding foot note represents the œsophagal opening as somewhat removed from the left branchial opening, but in all the specimens which I have examined its position is so close to the left branchial opening as to form one cavity with it.

The specimen dredged by Messrs. Packard and Cooke came up from a soft, muddy bottom. Those collected by Mr. Mills were obtained principally while feeding on the offal thrown overboard by the fishermen at Grand Menan, while those collected by the Hassler Expedition, in the Straits of Magellan, were obtained by placing the bodies of dead birds, etc., in pot nets, and allowing the nets to remain for a time, when the slime-eels would be found in great numbers buried in, and feeding upon, the flesh.

On September 18, 1873, Messrs. Packard and Cooke, while on the "Bache," and acting under the direction of Prof. Baird, U. S. Commissioner of Fisheries, dredged a specimen of Myxine in one hundred and eighteen fathoms on a blue-mud bottom, just east of Jeffrey's Ledge (directly east from Portsmouth). Dr. Packard's notes give the temperature of the bottom as 35°, and of the surface, 57°.

This specimen was brought to Salem alive, but died before I had the opportunity of examining it. When examined, very soon after death, it was of a light blue color above, whitish below, with a reddish tint over the whole body, evidently caused by the blood showing through the thin skin. The mucous sacs were very conspicuous as two abdominal rows of white spots. The membranous fins were transparent, and well defined from the skin.

The specimen is twelve inches long, and not quite half an inch in depth at the branchial apertures. The head (under this term I designate the portion forward of the branchial apertures) is one quarter of the total length of the animal, and its length is contained two and one half times in the abdominal portion (the portion embraced between the branchial apertures and the anus). The tail (measured from the anus to the tip) is one eighth of the total length. The lingual teeth are the same on each side, the outer row being composed of the largest teeth, as is the case with all known specimens of the genus. There are nine in the outer, and ten in the inner row. The two foremost of each row are the strongest, and are confluent at the base.[1] The dorsal fin commences a little more than the length of the tail in advance of a point over the anus. This specimen is not fully developed, but with the aid of a lens, minute eggs can be seen in the ovary.

On examining three specimens contained in the Museum of the Peabody Academy of Science, and collected by Mr. Mills at Grand Menan, during the season of 1857, I found one that was much more slender than the others, agreeing very closely in its proportions and the length of the dorsal fin, with the specimen described above. This is a fully developed female, with large eggs. It measures fifteen and one half inches in total length, and .6 of an inch in depth. The head is one quarter the total length, and is contained two and and one half times in the length of the abdomen. The lingual teeth vary in number on the two sides; the right side having eight in the outer row, and eleven in the inner; the left side has nine in the outer, and ten in the inner row.

The other two specimens from Grand Menan are at once noticeable from their more contracted form. They agree in their relative proportions, and in having a short dorsal fin, which commences but little in advance of a point over the anus. One of these is a fully developed female, with large eggs. It is fourteen inches in length, and .7 of an inch in depth. The head is contained three and one half times in the total length, and twice in the length of the abdomen. The tail is contained seven and three quarter times in the total length. The lingual teeth are ten in each row.

The third specimen is a female, with the eggs but little developed. It is 12.9 inches long, and .6 of an inch in depth. The head is contained three and one half times in the total length, and twice in the length of the abdomen. The tail is contained seven and one half times in the total length. The lingual teeth are nine in each row.

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[1] A character which is common to all the specimens of the genus I have examined, though it has been stated that in *M. australis* the first three teeth are confluent.

From these descriptions it will be seen that these four specimens exhibit two forms, or extremes of variation: one being elongated with a tendency to a long dorsal fin, and the other shorter, with a tendency to a short dorsal fin. It will also be noticed that the number of lingual teeth is not constant, and that we cannot consider the variation in their number of any specific value.

On examining the many specimens from Grand Menan, contained in the Museum of Comparative Zoology, I found that while the short form and the long form were to a certain extent recognizable, yet there were several specimens intermediate in some one or more of the characters, and that the two forms could only be regarded as varieties exhibiting the extremes of variation in the species.

On reducing the few measurements which Girard gives in his description of *M. limosa* to the relative proportions of parts, it will be seen that his description was taken from an elongated specimen, and as the only character given by Günther by which his slender specimen, described under the name of *M. affinis*, could be distinguished rom *M. limosa* is the number of teeth,[1] we are forced to consider *M. affinis* as a synonyme of the variety first described by Girard.

On comparing the specimens from the English coast with the short form from Grand Menan, I could find no difference between them.

I then made a thorough study of the two hundred specimens of various sizes collected by the Hassler Expedition in the Straits of Magellan, and found that it was impossible on any character to separate them from the northern representatives of the species.

The following table, giving the measurements of a number of the specimens from each locality, the number of teeth, and the relative proportions of the head, abdomen and tail, will best exhibit the facts.

After dissecting between forty and fifty specimens of Myxine, I have been unable to find a single one that was unquestionably a male. All but two of the number dissected (and in the majority of the specimens not opened the eggs could be felt by pressing on the walls of the abdomen) had eggs in a more or less advanced stage. In many specimens the eggs were quite large, in others they were smaller; in others again they were quite small, and the ovary was

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[1] Girard states that the teeth in his specimen were seven in each row, but as I have never found less than eight I am inclined to think that Girard overlooked the small tooth at the end of each row. Günther gives the teeth of his *M. affinis* as eleven. I have shown that the number varied in the elongated specimens alone, as described above, from eight to eleven.

TABLE OF MEASUREMENTS OF EIGHTEEN SPECIMENS OF MYXINE.

Locality.	Sex, etc.	Teeth.	Total length.	Depth of body.	Head contained in total length.	Head contained in abdomen.	Tail contained in total length.
Puerto-bueno, Strs. Magellan.	Young.	8–8	4 in.	$\frac{3}{10}$ in.	$3\frac{1}{4}$ times.	$1\frac{4}{5}$ times.	7 times.
“ “ “	“	8–8	$5\frac{6}{10}$ “	$\frac{3}{10}$ “	$3\frac{1}{4}$ “	$1\frac{4}{5}$ “	$7\frac{1}{3}$ “
Grand Menan.	♀ minute eggs.	——	10 “	$\frac{4}{10}$ “	4 “	$2\frac{7}{8}$ “	$6\frac{1}{2}$ “
Coast of England.	♀ “ “	——	$10\frac{1}{2}$ “	$\frac{5}{10}$ “	$3\frac{1}{2}$ “	2 “	8 “
“ “	♀ small “	8–9	$10\frac{1}{2}$ “	$\frac{6}{10}$ “	$3\frac{1}{2}$ “	2 “	7 “
Sandy Point, Strs. Magellan.	♀ large “	9–10	$11\frac{1}{2}$ “	$\frac{5}{10}$ “	$3\frac{2}{3}$ “	2 “	$7\frac{3}{4}$ “
Coast of England.	♀ small “	8–10 9–10	12 “	$\frac{6}{10}$ “	$3\frac{2}{3}$ “	$2\frac{1}{6}$ “	$6\frac{1}{2}$ “
Eastern Coast United States.	♀ minute “	9–10	12 “	$\frac{4}{10}$ “	4 “	$2\frac{1}{2}$ “	8 “
Sandy Point, Strs. Magellan.	♀ large “	9–9	$12\frac{1}{2}$ “	$\frac{5}{10}$ “	$3\frac{2}{3}$ “	2 “	$7\frac{1}{3}$ “
“ “ “ “	♂ ? Testes not developed.	9–9	$12\frac{1}{2}$ “	$\frac{5}{10}$ “	$3\frac{2}{3}$ “	$2\frac{1}{5}$ “	$7\frac{1}{3}$ “
Grand Menan.	♀ small eggs.	9–9	$12\frac{9}{10}$ “	$\frac{6}{10}$ “	$3\frac{1}{2}$ “	2 “	$7\frac{1}{2}$ “
“ “	♀ large “	10–10	14 “	$\frac{7}{10}$ “	$3\frac{1}{2}$ “	2 “	$7\frac{3}{4}$ “
“ “	♀ “ “	8–11 9–10	$15\frac{1}{2}$ “	$\frac{6}{10}$ “	4 “	$2\frac{1}{2}$ “	$8\frac{1}{4}$ “
“ “	♀ “ “	10–10	16 “	$\frac{7}{10}$ “	$3\frac{2}{3}$ “	2 “	8 “
“ “	♀ “ “	——	16 “	$\frac{7}{10}$ “	$3\frac{3}{4}$ “	$2\frac{1}{4}$ “	$8\frac{1}{4}$ “
“ “	♀ small “	9–9	$16\frac{1}{2}$ “	$\frac{7}{10}$ “	$3\frac{2}{3}$ “	$2\frac{1}{4}$ “	$8\frac{1}{4}$ “
Port Famine, Strs. Magellan.	♀ minute “	10–10	$16\frac{1}{2}$ “	$\frac{7}{10}$ “	$3\frac{2}{3}$ “	$2\frac{1}{7}$ “	$8\frac{2}{3}$ “
“ “ “ “	♀ very large eggs. . . .	10–11	$21\frac{1}{2}$ “	1 “	$3\frac{1}{3}$ “	2 “	10 “

just beginning to develop as a fringe; at this stage there was always a mass of fat in large flakes along the edge of the ovary, which was not present at any other stage. In those specimens where the ovary was simply a thin narrow band running along the side of the intestine, the eggs could be traced by using a lens. In two specimens from the Straits of Magellan no eggs could be traced, even by a careful microscopical examination made by Dr. Packard and myself, and though we could find no trace of spermatic cells, I am inclined to consider these two specimens as males, with the testes undeveloped, simply from the fact that in all other specimens with the ovary of no more corresponding development, minute eggs could always be made out.

Prof. Steenstrup has called attention to the fact that the single specimen which he describes is the only instance when the eggs have been found with the hard, or horny, shell, and its little hooks for attachment, and it is singular that in all the specimens that have passed through my hands, embracing as they do many that have the eggs as large, and even larger than those figured by him, not one shows the least development of the horny covering, or of the hooks, though the large eggs are all enclosed in a tough membrane, which unquestionably is the stage just preceding the one which he describes. The large, or nearly mature, eggs are from ten to eighteen in number in all the specimens I have examined, either from Grand Menan or the Straits of Magellan; sixteen is the most usual number. In one specimen from Grand Menan the large eggs were sixteen in number, and measured .8 of an inch in length and .4 in width. In a very large specimen from the Straits of Magellan, of a total length of 21½ inches, the large eggs were also sixteen in number, and measured .9 of an inch in length by .4 in width.

The collection made in the Straits of Magellan by the Hassler Expedition, shows conclusively that the time at which the eggs are excluded is not the same with all the females, for in each lot of specimens collected, during the few weeks in March that the Expedition was in the Straits, there are females with the eggs in all the different stages of development, and the specimens collected at Grand Menan, probably from August to October, show the same to be the case. It is very probable, however, that the large eggs in all these specimens would very soon have attained their horny envelopes and hooks, and it is reasonable to suppose that in the Straits of Magellan many eggs are deposited by April or May, and that on the Grand Menan coast many of the eggs would be mature about the first of winter.

The characters of the single species at present known,[1] I should express as follows.

Myxine glutinosa Linn.

Blue above, whitish below. Head contained in total length from three and one half to four times; in length of abdomen from two to nearly three times. Tail contained in total length from six and one half to ten times. Lingual teeth from eight to eleven in each row.

Habitat. Northern coasts of Europe, northeastern coast of North America, southern coast of South America.

Variety *septentrionalis*. Head contained less than four times in total length. Dorsal fin commencing over the anus. Habitat. Northern Atlantic.

Variety *limosa*. Head contained four times in total length. Dorsal fin commencing forward of a point over the anus. Habitat. Northern Atlantic.

Variety *australis*. Habitat. Southern coast of South America.

As I have already stated, I consider these varieties as simply indicating the extremes of variation in the species, and its geographical distribution, and not in any sense distinct forms.

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[1] The following are the characters which Dr. Günther, in his eighth volume of Catalogue of Fishes in the British Museum, gives to the three species of the genus which he acknowledges: —

1. **Myxine glutinosa** Linn. [and of various authors, including the *Gastrobranchus cæcus* of Bloch, the *Myxine cæca* of Blainville, and the *Myxine limosa* of Girard].

"Eight or nine rather slender teeth in each of the two series; the two foremost strongest and more confluent at the base than the others."

"Coasts of Europe and North America." [Günther's specimens were from the Firth of Forth, and from Newcastle.]

2. **Myxine affinis** Günther.

"Eleven rather stout teeth in each of the two series, the two foremost strongest and more confluent at the base than the others. Body considerably more slender than that of *M. glutinosa*."

"Habitat unknown. The single specimen is twelve inches long."

3. **Myxine australis** Jenyns, Voy. Beagle, Fish., p. 159.

"Ten or eleven slender teeth in each of the two series, the three foremost are strongest and confluent at the base, the other teeth remaining separate; in the second series the two innermost teeth are confluent at the base."

"Southern coasts of South America." [Günther's specimens were from Sandy Point and the Tyssen Islands.]

November 19, 1873.

The President in the chair. Seventy-nine persons present.

The following papers were read: —

ON THE TRANSFORMATIONS OF THE COMMON HOUSE FLY, WITH NOTES ON ALLIED FORMS. BY A. S. PACKARD, JR., M.D.

It is not a little strange that the history and transformations of the common House Fly are so little known. There is a vague idea that it breeds in the manure of stables, but no one in this country has investigated its habits, and even Dr. Harris, by describing our common species under a separate name, seems to indicate that ours is not the common House Fly of Europe. In Europe, even, but little attention has been given to its habits. They are mentioned only in three works, one of which (by Bouché) was published during this century, with figures so poor and inadequate as to be actually misleading.

Having been fortunate enough to find the larvæ of this species in large numbers and then in inducing the adults to lay eggs in great abundance at our own pleasure, as it were, we make the attempt to clear up the history of the development and transformations of *Musca domestica* Linn.

Bibliography. After Linnæus had described this species as the *Musca domestica*, DeGeer[1] was the first to satisfactorily describe its transformations. He says that the larva lives in warm and humid dung, but does not say how long it lives in the egg, larva, or pupa state. He gives a good description of the larva, stating that its prothoracic stigma ends in six divisions, and adds, "Ces larves, que sont absolument sans pattes, n'ayant pas même ces mamelons charnus qu'on observe à celles de la viande [*Musca carnaria*] et de quelques autres especes, se sont des cocques de leur propre peau, mais qui n'ont rien de particulier à offrir et les mouches en sortent peu de jours apres (p. 78, Tome 6, 1776).

In 1834 Bouché[2] described the larva, remarking that it lives in horse's and fowl's dung, especially when warm. He does not, however, state how long it remains in this state. After a fair description of the pupa-case, he says that it remains in this state from eight to fourteen days. His figures of the larva and pupa-case are very poor, not being recognizable; but this is the only time, so far as we are aware, that the insect has been figured in its preparatory stages.

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[1] Carl De Geer. Mémoires pour servir à l'histoire des Insectes. Stockholm, 4°. 1752–'78.

[2] P. Fr. Bouché. Naturgeschichte der Insekten, etc. Berlin, 1834. 12°. The third work we have alluded to is by Keller; Geschichte der gemeiner Stubenfliege, 1764 and 1796. This last we have not seen.

We have been unable to find any other references, of any importance from a biological point of view, to this commonest of insects.

Embryology. During the month of August the House Fly is extremely abundant, and as we, and others, have noticed, especially so in the neighborhood of stables. On placing one fly in confinement in the shade, enclosed in a glass bottle, she laid some time between six P. M., August 12th, and eight A. M., August 13th, one hundred and twenty eggs. They were deposited irregularly in stacks, as it were, lying loose in one or two piles at the bottom of the bottle. At eight A. M., August 14th, several were found hatched out and crawling about the bottom of the bottle.

In order, however, to obtain a large number of eggs, we placed a mass of freshly dropped horse manure, still warm, at an open window in the sun. This attracted large quantities of flies for three or four weeks succeeding, which laid eggs during that period. Immediately on exposing the manure on the morning of the 12th of August, the flies appeared and laid their eggs in masses in the crevices in the manure, working their way down mostly out of sight, and depositing bunches of eggs in various convenient places. These were found hatched out at about the same hour the next day. From several such experiments made on different occasions, we may regard the embryo as requiring twenty-four hours for perfection. In confinement it requires from five to ten hours more, and those larvæ hatched in confinement are smaller than those reared from eggs deposited in warm manure. It is evident that heat and moisture are required for the normal development of the larva, as usual in all insects. Thus the egg state lasts for twenty-four hours, about the time of that of *Musca vomitoria*, according to Weismann,[1] who states that it lasts from seventeen to twenty-six hours.

The egg is elongate oval cylindrical, a little smaller, more pointed at the anterior end than the posterior. It is .04–.05 inch long, and about .01 inch in diameter. The chorion is thin and structureless, but covered by an outer shell, which renders the egg quite opake, so as to prevent one from making out the earlier embryonic changes. It is evidently secreted and laid upon the chorion just before the egg is laid. Its surface is pitted with elongated hexagonal depressions, which cross the egg transversely. Compared with the eggs of *Calliphora vomitoria*, the Meat Fly, they are rather smaller, those of the latter being .06 inch in length, and thicker in proportion, while the hexagons are in the Meat Fly larger and longer. The eggs of both flies are dull chalky white.

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[1] Die Entwickelung der Dipteren im Ei, nach Beobachtungen an Chironomus, Musca vomitoria und Pulex canis. Zeitschrift für Wissenschaftliche Zoologie XIII., p. 107–204. 1864.

The micropyle is round, and easily perceived on twisting the egg under the compressor.

The yolk granules are exceedingly fine, as in *C. vomitoria*, so that the yolk is quite dense.

Owing to the density of the *exochorion*, as we may term the outer shell, it was impossible to observe the earliest embryonic changes, the formation of the blastoderm, and the primitive band. From one specimen hardened in alcohol, we succeeded in tearing off the exochorion by aid of the compressor and needles, an operation which we could not succeed in doing on recent eggs, as they invariably broke. This stage apparently agrees with that of *Calliphora vomitoria*, figured by Weismann on Taf. v., figs. 65, 66.

A more advanced stage, as seen through the exochorion, is represented by Weismann's figures 71 and 72.

At a more advanced stage (Pl. 3, Fig. 1) the embryo is nearly fully formed. The segments and locomotive spines crossing the under side of each segment are formed. The head is indicated; the two tubercles probably indicating the 1st maxillæ; the head is much larger compared to the size of the prothorax, than subsequently, and the dark Y-shaped twin spots indicate the formation of the œsophageal frame work. The anal spiracles are formed, but the spiracles are still somewhat rudimentary, though the tracheæ leading from them appear to be fully formed.

Just before the embryo hatches, the body becomes more transparent, and, as seen in Fig. 2, the main tracheæ can be traced through their whole length, with their lateral and cephalic branches. The rows of locomotive spines are very distinct. They can be easily seen in the egg in its natural state, but the figure represents the living egg with the exochorion removed, this covering having already split along the under side, just as we have seen it in *C. vomitoria*.

We feel warranted then in stating that the embryological development of *Musca domestica* is in all its stages almost identical with that of *Calliphora vomitoria*, so elaborately worked out and copiously illustrated by Weismann, in his famous work.

When the embryo is about to slip out of its egg-membranes, including the amnion, which we have observed to be as usual in the insects, it is quite active in its motions, the body moving to and fro within the shell. Undoubtedly this motion, accompanied by a twisting motion of the body, ruptures the exchorion.

We did not witness the process of hatching of the House Fly, but have no doubt it is like that of the Meat Fly (*C. vomitoria*). A larva of the latter hatched under our eyes. The egg-shell split longitudinally, and in one or two seconds it pushed its way out through the anterior end, and in a second or two more extricated itself from the shell. The shell scarcely changed its form, and the larva left the amnion within.

The larva. First stage. (Pl. 3, Fig. 3, 3*b*.) In order to bring out more clearly the characters of this stage, we shall compare it with the freshly hatched larva of the Meat Fly (*C. vomitoria*), which we studied at the same time in order to test our work on the House Fly.

The larva as soon as hatched, on being compared with that of the Meat Fly of corresponding age, differs from the latter in being slenderer, with the head in front rounder and narrower, while the posterior end of the body is rounder and narrower. The sutures in *M. domestica* are much less plainly marked, especially the three anterior ones. There are but seven rows of locomotive spines, where in C. *vomitoria* there are twelve, one for each segment (Weismann does not figure the last and minute row). Moreover, the spinules are less numerous than in *C. vomitoria.* These rows of spinules appear more clearly than in the fully grown larvæ in both genera. These differences we would regard as good generic characters, and these are, with the other characters given below, the only differential characters by which to distinguish the larvæ.

The head is much less free from the succeeding, or prothoracic, segment than in *C. vomitoria*, the suture behind being less distinct. The end of the body below the stigmata does not project so conspicuously as in *C. vomitoria.*

There are also good generic characters in the tracheæ. In *M. domestica* the two main tracheæ are more sinuate, and do not taper so rapidly anteriorly, while the distance from the posterior commissure to the stigma is greater, and the dark terminal portion longer, than in *C. vomitoria.* The secondary branches are rather shorter than in *C. vomitoria*, and the two inferior medio-posterior tracheal twigs (Fig. 3 *b*) arise behind the posterior commissure. The tracheal twigs of the head are distributed much alike in both genera.

The length of the freshly hatched larva of *M. domestica* is .07 inch. It remains in this stage about twenty-four hours.

The second stage. (Fig. 4.) This stage is signalized by the addition of the prothoracic stigmata. This change must necessarily, though we did not perceive it, be accompanied by a moult of the first larva skin, as in *Calliphora vomitoria*, according to Leuckart[1] and Weismann (*l. c.*).

The length of the larva at this stage varies from .15–.17 inch in length. It is considerably slenderer than in the first stage. We are inclined to think that this stage lasts from about twenty-four to thirty-six hours. One of these larvæ grew .05 inch in twenty-four hours.

The third stage. As this last stage does not differ from the preceding one in any important respects except size, the following description will apply to both.

The larva of *M. domestica* differs from *C. vomitoria* in being proportionally longer and slenderer, more regularly conical, the body gradually increasing in width to the end, which is square. The propleg is small and inconspicuous as compared with that of the other genus, and cannot be seen from above when the larva is in motion. In Calliphora the body narrows towards the end, the stigmatal hollow is very well marked, with eight large subacute conical tubercles on the elevated edge of the round area, which in life is stuck outwards and upwards, presenting a cup-like hollow, at the bottom of which the stigmata are situated. They are large and tun-shaped, deep testaceous in color, with fine longitudinal whitish stripes; while in *Musca domestica* they are black, external, being situated in a very slight depression, and are very conspicuous.

The anal spiracles in *M. domestica* (Fig. 5; 5 *a*, still more enlarged spiracle of a younger larva than 5) are rounded, forming about three-fourths of a circle, with the opposing sides square, and a broad dark chitinous ridge, which becomes wider and darker with age. The openings are two, very unequal, the longer one apparently formed by the union of what were probably originally two openings. These openings are very sinuous, the fissure guarded by dense projecting cones. This sinuate course of the spiracles is the most prominent differential character of the genus Musca. Fig. 6 shows their disposition in *Calliphora vomitoria*, and Fig. 7 their arrangement in *Sarcophaga carnaria*, being slenderer and situated farther apart in the latter genus.

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[1] Die Larven zustände der Musciden. Archiv für Naturgeschichte, 1861, p. 60.

The spiracle on the prothoracic segment (Fig. 4 *c*) is divided into six lobules, rarely into eight. Fig. 4 *d* shows the end of one of these lobules, with a corrugated rim, and a central slight fissure for the admission of air.

The head (Fig. 4 *a*) is conical, about half as long as the prothoracic segment in the larva of the second stage, but much smaller proportionally in the fully grown maggot. The antennæ are minute, conical, two-jointed, the terminal joint minute, acutely pointed. Below are two fleshy tubercles, probably representing the maxillæ, and a single one, representing possibly the labrum, or upper lip. The black horny mandibles are of the usual form of the family.

The body of the maggot is much more transparent than in Calliphora or Sarcophaga. The region next the sutures, between the segments, is scarcely thickened, while it is conspicuously so in Calliphora, and the tegument is smooth and shining, while in Calliphora it is opake and finely shagreened.

Length when fully grown, .25–.40 inch (while *C. vomitoria* measures .55–.60 inch). It probably remains in this state about three or four days. The entire life of the larva is, then, from five to seven days.

We are inclined to think that the larvæ, if hard pressed for food, devour each other, as of four larvæ put in a bottle, only two were found the day after. In the manure they eat up the decaying matter, leaving the bits of hay and straw.

Among the literally thousands of larvæ which have passed under our eyes, we have not as yet been able to detect an individual in which the body had decidedly contracted and changed its form preparatory to the formation of the puparium, and are inclined to believe this to be a comparatively sudden act.

For convenience in comparison, and to make this essay more complete, we give a brief description of the larva of *Sarcophaga carnaria*, the maggot of the common Flesh Fly, which has been known to be an inhabitant of this country for about a century, as DeGeer mentions it in 1776, in his "Mémoires," as having been received from

Pennsylvania. It is closely similar to *Calliphora vomitoria*, but a little longer. There are eleven divisions or lobules to the prothoracic stigmata, where in *Calliphora vomitoria* there are nine. The locomotive spines are more acutely pointed. The anal spiracles are of the same relative size as in Calliphora, but the openings are much longer and narrower, and consequently farther apart, and the circular orifice in the peritreme is wanting; in both genera the peritreme is round, while in Musca it is somewhat hemispherical. The fleshy projections around the spiracular depression, and the two fleshy prop-legs are the same in the two genera, Sarcophaga and Calliphora, while the head and its appendages present no differences. The only character by which to distinguish the larvæ of the two genera is in the form of the stigmata. The mode of life, and of taking food, is identical in the two; they differ but slightly in size, and here we have in the preparatory state of two allied genera, no specific characters developed, the differential ones are generic in their nature. And yet the imagines are very different, with a number of specific characters separating them.

The puparium (Fig. 8, ventral; 8 *a*, dorsal view, enlarged) is regularly cylindrical, at the fifth segment from the head beginning to taper regularly towards the head, the anterior end being distinctly pointed, the rudiments of the head and prothorax being small. Posteriorly the body is much rounded, full and obtuse, with no spiracular depression nor spines surrounding it, but the spiracles are situated conspicuously like little buttons on the end. On the dorsal side of the body is a single row of coarse granulations along the suture, becoming beneath double, with fine lines crossing and connected with the granulations, the distance between the rows widening posteriorly. Numerous granulations, rather finer than those anterior, surround the rudiments of the prop-legs. A raised sharp prominent lateral ridge extends on each side from the mesothoracic segment on to the first abdominal. Prothoracic spiracles very minute, with usually six lobules, and not extending beyond the mouth parts. The prop-legs are represented by two oval flattened parallel contiguous tubercles, with a rather remote and obscure area on each side. The anal spiracles form black, round, flattened, button-like tubercles, the terminal segment being smooth and shiny, and regularly convex.

Length, .20–.27 inch.

So remarkably similar is the puparium of *Musca domestica* to that of *Stomoxys calcitrans*[1] (Fig. 10, dorsal; and 10 *a*, ventral view of an immature puparium, in which the pupa is very rudimentary, the abdomen being continuous with the thorax) that it is difficult to give any characters by which to separate them. The two most important ones are the following; the anal spiracles of *Musca domestica* (Fig. 9) are larger, much closer together, square on the opposing faces, and depressed in the middle, while those of *Stomoxys calcitrans* are remote, round, and flat topped. (10 *c*.) The lower side of the end of Stomoxys is darker and much more rugose, owing to transverse ridges, than in Musca, where it is comparatively smooth. Fig. 10 *b* gives an idea of these ridges and transversely oval enclosures. The ridges lying between the spiracles and the region of the proplegs are wanting in *Musca domestica.*

In both genera the prothoracic spiracles of the pupa connect with similar projecting, slightly twisted, long acute points which are situated on each side on the hinder edge of the metathoracic segment of the puparium. These stigmata are not represented in either of the drawings of the puparia we here present. The divisions of the prothoracic stigmata in the puparium of Stomoxys are five in number. The puparia of this species occurred more abundantly with us than those of the Domestic Fly, and were at first mistaken for them. The puparium of *M. domestica* may at once be distinguished from Calliphora and Sarcophaga by the obtusely pointed (compared with those of *C. vomitoria* and *S. carnaria*) end, and the full rounded hind end, with the spiracles externally like buttons; also by its smaller size, and by the double row of large granulations, while in Calliphora and Sarcophaga there are twelve or more.

In Musca, as well as in Stomoxys, when the pupa is formed, the hard frame work of the jaws of the larva rest next to the skin of the puparium, and always on the ventral side, and apparently in connection with the old larva skin. When the fly pushes its way out of the pupa case, the anterior end of the latter splits off just behind the suture between the metathoracic and first abdominal segment. And often when the front end of the puparium is forced off, the ventral half, with most of the rudiments of the mouth-parts, remains attached to the case.

A parasite found in the puparium of *Musca domestica* will be described at the end of this essay.

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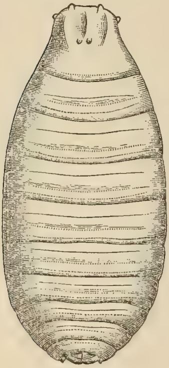
[1] As has been noticed by Bouché (*l. c.*, p. 56) as regards the larval state.

The puparium of *Calliphora vomitoria* is cylindrical, slender, flask-shaped, being thickest on the anterior third of the body, thence gradually narrowing to the posterior end and suddenly contracting, leaving a well marked neck, which is much darker colored than the rest of the body, which is of the usual dark red color. The spiracles are quite prominent, extending as far as the extreme tip of the head; they are of much the same form as in the larva, and with from twelve to thirteen deeply marked divisions. (In one larva there are nine lobules.)

Two broad bands and a narrow linear accessory line of minute granulations cross each segment, and become curved a little anteriorly along the dorsal line. The constricted end of the case is provided with twelve prominent rugose granulated spines, with longitudinal ridges on the neck terminating between the spines; and along the ventral side of the neck is a ridge, less sharp and prominent than in Sarcophaga, and with larger granulations. The rudiments of the prop-legs consist of two lateral conical projections and a median furrow. The projections are a little farther apart, and more slender than in Sarcophaga, but the differences are very slight. The dorsal ridge ending between the two uppermost circum-anal projections is obscurely marked, while in Sarcophaga it is distinct and sharp.

The divisions of the stigmata are very plainly and deeply cut, while in *Sarcophaga carnaria* there are no indications of the incisions, the edge being rugose, but not crenulated. This is the most important distinguishing mark in the puparia of the two genera. Length .30–.35 inch.

The puparium of *Sarcophaga carnaria* (described from specimens received from Rev. Mr. S. Lockwood) is twice as bulky as that of *Calliphora vomitoria*. It is cylindrical, not tapering so gradually posteriorly as in *C. vomitoria*, and not contracted at the end into so long a neck. The twelve blunt spines surrounding the spiracular region are much smaller, less conspicuous, and do not project, except the two lower ones, beyond the end of the puparium. The ridges ending between these spines are much higher and sharper than in *C. vomitoria*. The dorsal



Puparium of *Sarcophaga carnaria.*

ridge on this neck is much sharper and more pronounced than in *C. vomitoria*, and the impressed lines on the sides extend forwards to the suture between the penultimate and terminal segments of the body, the lines curving outwards anteriorly. There is a well-marked pointed short ventral ridge behind the rudiments of the ventral proplegs. This ridge is obscurely marked in the puparium of *C. vomitoria*, except that the prothoracic spiracles are much less prominent, not projecting beyond the head, their extremities being just parallel with the end of the rudimentary mouth-parts. The edge of the spiracle is rugose, but I have been unable to distinguish any signs of lobules. The lines of pointed granulations are arranged much as in *C. vomitoria.* Length .50 inch.

The pupa. (Fig. 11.) The pupa of *M. domestica* may at once be known by its broad spatulate labium or tongue, and the curved, almost elbowed maxillary palpi. The antennæ (Fig. 11 *d*) are distinctly three-jointed, with a large, stout bristle. Fig. 11 *a* shows one of the legs with the trochanter hanging to it; Fig. 11 *b* the wing, surrounded by its membrane; and Fig. 11 *c* the optic lobes, and their connection with the unorganized cornea and facets of the eyes; the outer surface of the eye being covered with fat cells, destined to form pigment cells, which finally turn reddish.

The figures 12, 12 *a*, 12 *b*, show the corresponding stage in the pupa of *Stomoxys calcitrans*; here can be seen the generic characters which separate this fly from the House Fly, *i.e.*, the elongated beak, the smaller, narrower, more pointed head. The mouth-parts with the long maxillæ (*mx*) and mandibles (*m*), and the straight maxillary palpi, are shown in the enlarged view (Fig. 12 *c*).

On removing the puparium we were able to obtain a portion of the semipupa of Stomoxys (Figs. 13, 13 *a*) *i.e.*, the thorax, the head adhering to the pupa-case, and only the basal segment of the abdomen being brought to view; enough, however, to show that they were nearly of the form of those of the larvæ. This stage compares almost exactly with that of *Calliphora vomitoria*, as figured by Weismann, Tab. XII., Figs. 38, 39, 40. This stage is intermediate between the larval and pupal, and may be properly termed the semipupa.[1]

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[1] Professor von Siebold, in his "Beiträge zur Parthenogenesis der Arthropoden," 1871, p. 35, calls this stage *pseudo-nymph.* As this state is necessarily universal in all metabolous insects, it seems incorrect to regard it as a false or unusual state, and we therefore may be pardoned for retaining the name first proposed by us in 1866. (Proc. Bost. Soc. N. H., x, 279.)

Similar intermediate stages have been shown by us to exist in the Hymenoptera, Lepidoptera, and Coleoptera, and in other Diptera. It shows that the distinction between the larval and pupal stages are as truly artificial as in the ametabolous insects.

Fig. 13 is a dorsal view of the three thoracic segments, with the anterior leg attached, and the wings. The segments are very indistinctly marked. The prothoracic stigmata are very near together, though so widely separated in the fully formed pupa. Fig. 13 *a* is a ventral view of the same parts, the parts somewhat distorted; it also represents the wings, and the two hinder pairs of legs, and 13 *b* the fore leg; the joints of the legs are clearly indicated.

The next stage in the pupa of Stomoxys was much farther advanced, the thorax being formed much as in the mature pupa, as also the abdomen. The body is still much longer than in Fig. 12, the head narrower and freer from the body, and the vertex more elongated. The mouth-parts do not reach much beyond the anterior third of the body, while the wings reach only to the middle of the body (the head excluded), and the hindermost legs only reach a little beyond the middle of the body (the head excluded), and a little way beyond the end of the wings. Viewed dorsally, the thorax is much shorter than in the stage represented by Fig. 12, and the scutellum is short and small, being still quite rudimentary. The form of the eyes can just be distinguished, and the antennæ can with difficulty be perceived.

Fig. 12 represents the succeeding stage of the pupa of Stomoxys, which may be said to fairly represent the typical pupa condition of the cycloraphous diptera. At this time the body is pure white, the eyes are unchanged in color, and under low powers there are no traces of hairs to be seen. In this and the following stages the proportion in the length of the wings and legs, and mouth-parts, remains nearly the same. The wings reach to the middle of the abdomen, while the hind legs just pass beyond the tip end of the abdomen. The mouth-parts reach to the second abdominal segment. The eyes and antennæ are clearly indicated (the latter not shown in the drawing). The stages beyond differ but slightly, and form exceedingly gradual steps towards the imago. They differ chiefly in the degree of maturity of the tegument and hairs. In one example, in which the sutures are much more distinct than in Fig. 12, the body is slightly dusky, but the eyes are beginning to turn rosy around a portion of the edges. The hairs are also apparent. In a more advanced stage the eyes are a deep scarlet, the hairs are brown, the wings and legs are dusky.

The prothoracic spiracle, with its black, corneous tip, is much the same in all the specimens.

Having had more alcoholic specimens of the pupa of Stomoxys than of Musca, we have not been able to trace these stages in the latter genus, but doubt not that similar ones occur in all the Muscidæ.

The imago. On leaving its puparium the fly runs around, with its wings soft, small and baggy, much as in the pupa. They reach a little beyond the middle of the abdomen, and are still pressed to the side of the body. It is pale, as in the puparium, and the colors are not set. The membranous portion of the front is constantly distending as the fly walks rapidly about. When this part is contracted it forms a dull livid area, soft and fleshy, free from hairs. This portion suddenly distends into a bladder-like expansion, trapezoidal in outline, equal in bulk to the rest of the head, and pushing the antennæ down beneath out of sight. This thin membrane is evidently distended with air, and its connection with the tracheæ, and the mechanism of its movements, would form a most interesting subject of inquiry. This part has been described by Mr. T. B. Lowne, in his work on the "Anatomy of the Blow Fly," and he is evidently correct in regarding it as an organ for pushing away the end of the puparium when the pupa slips out of its case.

The common House Fly, though so abundant, is difficult to distinguish from the allied species. The generic characters may be found in the mouth-parts, already described by authors. In the venation of the wing it differs decidedly from Sarcophaga, in the end of the median vein being bent nearly at right angles, and in being regularly but slightly incurved, while in Sarcophaga, it is bent at a much lower angle, being much more oblique. From the genus Lucilia, which it much nearer approaches structurally, it differs in this vein being still bent at a greater angle, and in having the bent extremity more curved. In Stomoxys this vein is but slightly bent, thus widely differing, besides in its remarkably long horny beak, from Musca, with its short fleshy bilobed tongue.

The body of *M. domestica* is black; the head has a longitudinal reddish oval smooth area on the vertex, with the orbits and adjacent region golden (or silvery in some lights); the hairs are black, and the antennæ and plume are black. The thorax is black, tinged with golden gray on the sides, with three dorsal gray longitudinal bands, the middle one most distinct, the two lateral ones partially interrupted in the middle and continued on to the scutellum; there is a broad lateral golden gray band interrupted by the sutures. The base of the first abdominal segment has a yellowish band, interrupted in the middle. On the middle of the end of the two succeeding segments is a triangular mesial golden spot, with an oblique irregular band on each side, and farther down the sides golden; terminal segment golden. Base of wings, scales and halteres yellowish-white. Legs black.

The male differs from the female in the front between the eyes being about one-third as wide as in the latter, while she is rather the smaller. Length .22–.32 inch.

The species agrees in most particulars with Harris' description of *Musca harpyia* in his "Correspondence," and we are inclined to think that individuals of this species formed the subject of his description. After comparing it with about a dozen specimens of *Musca domestica* received from Switzerland (through the kindness of Mr. S. H. Scudder), we cannot find that it differs in any respect from them. The golden color that Harris calls silvery, the reddish oval spot on the vertex, the black hairs on the thorax, are the same in specimens from America and Switzerland. Both also agree in the venation and form of the head and front.

SUMMARY OF ITS HISTORY.

The eggs are laid about one hundred and twenty in number, and in twenty-four hours the larvæ are hatched.

There are three stages of the larval state, and consequently two moults.

The first stage lasts about one day (twenty-four hours).

The second stage lasts about one day.

The third stage lasts three or four days.

The entire larval state averages from five to seven days.

The pupal state lasts from five to seven days.

The period from the time of hatching to the exclusion of the imago lasts from ten to fourteen days in the month of August.

Those larvæ which were reared in too dry manure were nearly one-half smaller than those taken from the manure heap. For several days the larvæ living in this dry manure did not grow sensibly. Too direct warmth, but more especially the want of moisture, and consequently of available semi-liquid food seemed to cause them to become dwarfed.

Parasite of Musca domestica. While no insect parasite has yet been hitherto found, so far as we are aware, in the House Fly, it is, in fact, preyed upon by a Coleopterous larva. In one puparium we discovered a large hole which had been eaten through the crust in the anterior third of the body. Another puparium, on being opened, was found to contain the pupa of a beetle, of which Fig. 14 *a* is a dorsal, and Fig. 14 a ventral view. It is long and slender, with the abdomen unusually attenuate. Seen dorsally the prothorax is very broad, twice as broad and nearly concealing the head. The wings were free, not laid on the body; the anterior pair short and broad, the hinder pair much longer and narrower. The segments of the abdomen are convex, each side giving rise to a hair. The abdomen gradually narrows, the terminal segment being lunate. From under each side of it extends a remarkably long and large appendage ending in a long bristle.

Seen ventrally the filiform ten-jointed antennæ are widely inserted and diverge, extending along the front edge of the anterior wings, reaching a little beyond their middle. The hind tarsi extend to the middle of the abdomen.

The two most interesting characters are the slenderness of the body, and the large long terminal abdominal appendages, which are rarely met with in Coleopterous pupæ. From the sum of its characters here given we should feel inclined at present to locate this remarkable pupa in the family of Dermestidæ, with whose characters it agrees better than any other group of which we know the transformations. Of the vegetable parasites of the House Fly, of which there are several, we cannot now speak.

EXPLANATION OF PLATE III.

Fig. 1. Embryo of *Musca domestica* in an egg which has not been laid over twenty hours. Exochorion removed.

Fig. 2. Embryo of *Musca domestica* still farther advanced, the egg having been laid about twenty-four hours; the exochorion artificially removed, the embryo on the point of hatching.

Fig. 3. Larva of *Musca domestica* just hatched; showing the distribution of the two main tracheæ and the anterior and posterior commissures, (*a*, *a*) dorsal view. 3*b*, the same, showing the mode of origin of the pair of lower postero-median tracheal branches, seen from beneath.

Fig. 4. Larva of *Musca domestica* in the second stage; *sp*, prothoracic spiracle; 4*a*, head; *at*, antennæ; *mx*, maxillæ; *md*, mandibles; 4*b*, spiracles of *Musca domes-*

tica, divided into seven lobules. 4*c*, full grown larva of *Musca domestica*, showing the size of head relative to the prothoracic segment, with its spiracle; *a*, end of lobules of the spiracles; mouth enlarged.

Fig. 5. Two anal spiracles of *Musca domestica*. 5*a*, spiracle (much enlarged) of a younger larva than the subject of fig. 5, with a narrower peritreme, and the subcentral depression nearer the centre of the spiracle.

Fig. 6. Spiracles of *Calliphora vomitoria*.

Fig. 7. Spiracles of *Sarcophaga carnaria*.

Fig. 8. Ventral view of puparium of *Musca domestica*. 8*a*, prothoracic spiracles; 8*b*, end of body; 8*a*, dorsal view from two individuals of same puparium.

Fig. 9. Spiracles of puparium of *Musca domestica*.

Fig. 10. Puparium (immature) of *Stomoxys calcitrans*, dorsal view. 10*a*, the same, ventral view; *b*, head-end enlarged; *c*, prothoracic spiracles. 10*d*, profile view of end of puparium of the same. 10*e*, anal spiracles of the same.

Fig. 11. Pupa of *Musca domestica*. 11*a*, leg. 11*b*, wing. 11*c*, optic ganglia. *be*, optic lobes, divided into two well marked divisions; *oeg*, upper œsophageal ganglion, resting above the base of the optic lobes; *e*, eye in profile, and on the opposite side the unorganized mass of fat cells, out of which the optic fibres and chambers of the eye are to be developed. 11*d*, antenna.

Fig. 12. Pupa of *Stomoxys calcitrans*, front view. 12*a*, dorsal view. 12*b*, lateral view. 12*c*, head much enlarged; *m*, mandibles; *mx*, maxillæ; *mp*, maxillary palpi.

Fig. 13. Thorax of semipupa of *Stomoxys calcitrans*, dorsal view, showing the three thoracic segments. *st*, the prothoracic stigmata; *w*, wing; *l*, leg. 13*a*, ventral view of the same; *b*, fore leg.

Fig. 14. Pupa probably of one of the Dermestidæ, ventral view; *b*, dorsal view of the end of the body; *c*, ventral view; *d*, antenna. 14*a*, dorsal view of pupa. Found in Puparium of *Musca domestica*.

OBSERVATIONS ON THE SURFACE GEOLOGY OF NORTH CAROLINA, WITH SPECIAL REFERENCE TO SOME PHENOMENA OF THE DRIFT OF THE NORTHERN UNITED STATES.[1] By L. S. BURBANK.

Several years ago I had the opportunity to explore pretty thoroughly the midland region of North Carolina; which includes the hilly or undulating country between the foot hills of the Blue Ridge on the west, and the lowlands lying to the eastward of Weldon, Raleigh and Fayetteville.

Some of the facts then noted appear to me to have an important bearing upon questions connected with the subject of the Northern Drift. I propose therofere, first, to present some of the facts observed; second, to consider their relations to the phenomena of the drift.

My observations were made mostly in the counties of Wake, Granville, Franklin, Guilford and Chatham, N. C. The rock formations

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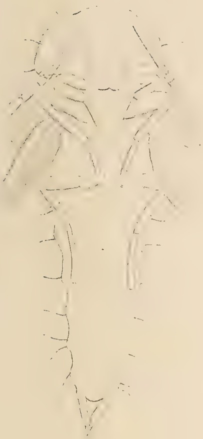
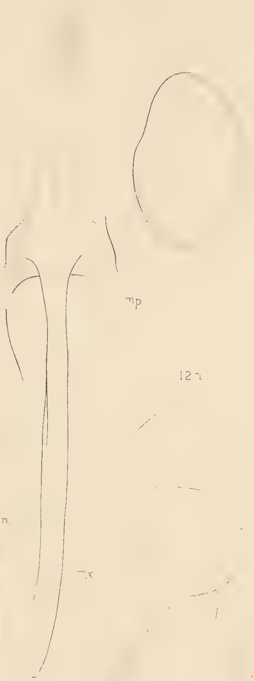
[1] The principal points embraced in this paper were presented in a verbal communication to this Society Nov. 20, 1872.

Plate 3

14



12c



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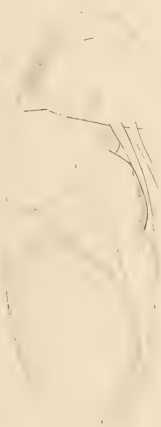

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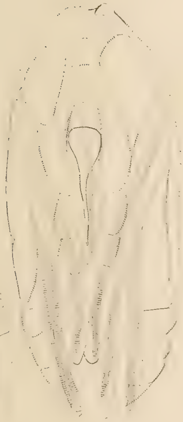
12

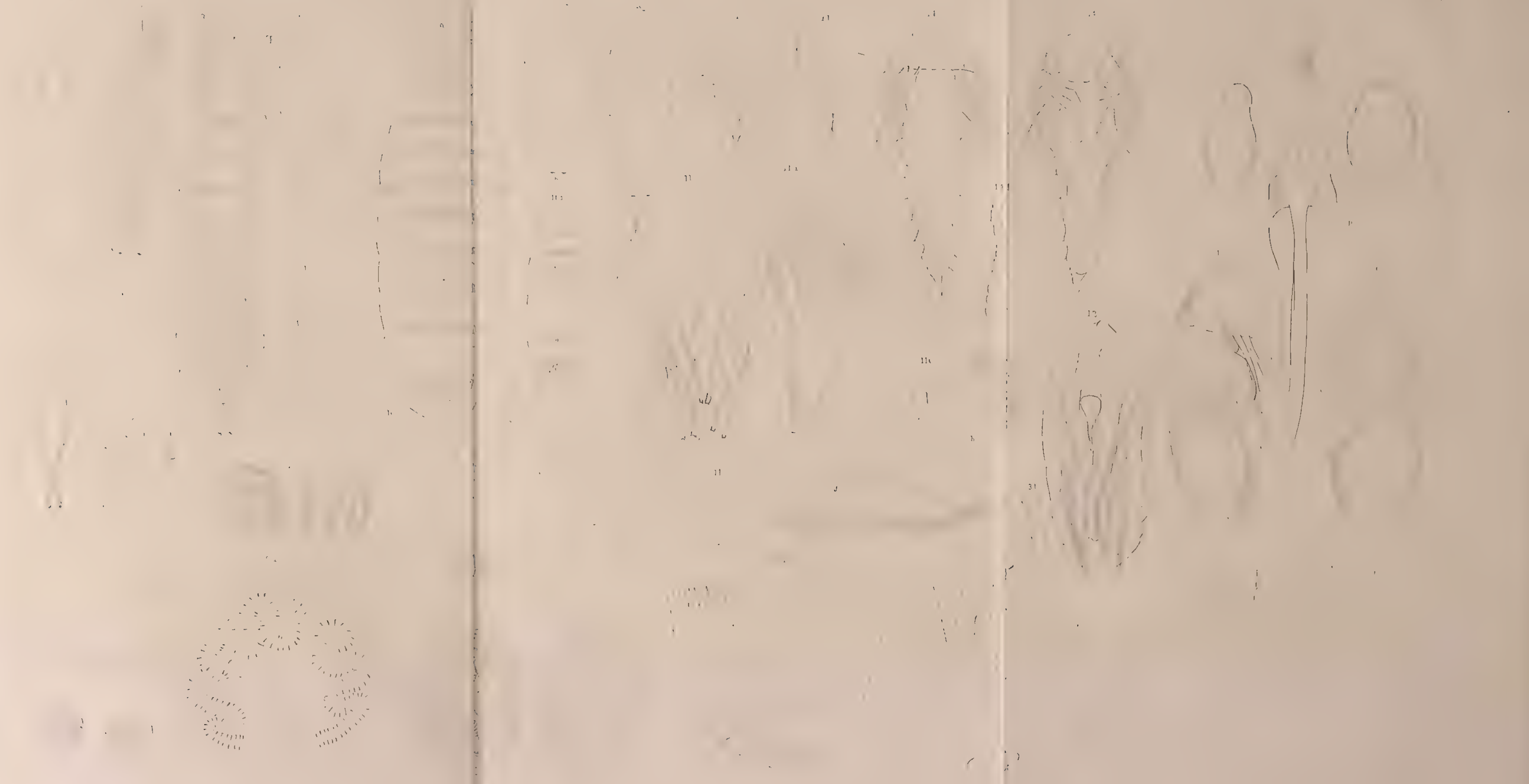


13b

13b

30

C.A.WALKER SC.



PACKARD, TRANSFORMATIONS OF THE HOUSE FLY

of a large portion of this region are strikingly similar to those of northern Massachusetts, east of the Nashua Valley. We find there the gneiss, passing by a gradual transition into mica and hornblende schists on the one hand, and on the other into metamorphic granites, sienites and greenstones, like those of northeastern Massachusetts. Among these latter rocks especially, there are found vast numbers of rounded, boulder-like masses lying partly buried in the soil. They are, however, always of the same kind as the rocks in place, above which they rest. I have observed enormous masses of this kind in Wake County, between Wake Forest College and Rolesville. Some of them far exceed in size any of the boulders of the New England drift, and yet have the characteristic form of boulders, not at all resembling the outcrop of ledges in the drift regions.

These boulder-like forms are very numerous near the village of Oxford, Granville County, where I studied them carefully. In this locality they are very abundant in the small valleys or ravines formed by the washing away of the loose material by the rains. In many instances the boulder-like masses are scattered over the summits of slight elevations, from which a portion of the material derived from disintegration and exfoliation has been removed.

That these rounded forms are not the result of attrition, but of chemical and atmospheric agencies acting upon rocks of a concretionary structure, is evident from their appearance and structure.

Excellent illustrations of this concretionary structure are to be seen in many places in the excavations along the line of the North Carolina Railroad, in Guilford County. At one locality near Jamestown the excavation was made through a little hill of sienite, about fifteen feet in height above the grade of the road. The greater portion of the rock is entirely disintegrated to a greater depth than the excavation extended; but the central mass of the knoll is made up of concretionary masses of sizes varying from five or six feet to less than one foot in diameter. Some of the concretions have the form of almost perfect spheres. When the excavation was made, one of these masses was split through the centre, thus showing plainly the concentric lines of incipient exfoliation. The loose, decomposed material around and above these masses still retains its position as in the original rock.

The trap dikes of this region also afford fine examples of the production of *boulders of decomposition*, as they have been aptly termed by Professor Hartt. On the road between Oxford and Hillsboro', near the bridge over Tar River, a trap dike which traverses the gneiss is filled with such boulders, which form a complete, but exceedingly rough pavement, where it is crossed by the road. The masses of trap in this locality are more nearly uniform in size than the granitic concretions, and are seldom more than ten or twelve inches in diameter.

So far as I observed, there were in this instance no appearances of a columnar structure in the trap. This fact may be an indication that what appears at the surface now was at, or near, the surface when the rock was consolidated, and the concretionary structure developed under slight pressure. In some other localities, especially in the river valleys, trap in the form of columns of greater or less regularity may be seen standing above the surface, marking the course of the dike. I noticed a fine example of this kind in a dike which traverses the sandstone at Haywood, Chatham Co., near the bridge across the Haw River. In this case greater pressure may have given the columnar form.

The undisturbed condition of the great mass of decomposed rock, which in this region covers the solid ledges, is shown by the veins and dikes which retain their original positions, and in many cases project above the surface, as just noticed in the case of trap dikes. The graphite vein near Raleigh may be traced for a great distance along the surface by the color it imparts to the soil. Granitic veins containing fine crystals of orthoclase and muscovite are occasionally found retaining their original positions, but so far disintegrated as to allow the different minerals to be easily separated.

A small vein of this kind, which I examined carefully, appears traversing the decomposed gneiss in an excavation on the Raleigh and Gaston Railroad, about six miles from Raleigh. This vein extends quite to the surface, but not above it, and along its course at the surface very few fragments removed from the vein could be found.

The granitic veins that I examined in this region were nearly all of a dike-like character, and quite unlike the great "endogenous" veins, which, in Massachusetts and New Hampshire, yield the fine crystals of beryl, tourmaline, and other minerals.

In their mineralogical character, in the structure and contents of the veins, and in many other particulars, the rocks of this region closely resemble those of northern Massachusetts east of the argillite band of Worcester county. It was this resemblance that first led me to make some comparative studies of the surface geology of these two regions.

It is well known that facts similar to those here noticed, have been observed in many of the warmer regions of the globe.

In Vol. IX. (p. 84), of the Smithsonian Contributions, Dr. Hitchcock, under the title of Erosion, speaks of the disintegration of the rocks by aqueous and atmospheric agencies in the States south of Pennsylvania. On page 94 also occurs this remark: "It is surprising sometimes to see to what depth the whole character of the rock will be changed, and how it will be disaggregated, so that aqueous agency can easily denude its surface." Had Dr. Hitchcock fully accepted the Glacial Theory of the Drift, he could hardly have failed to give these facts more prominence in the discussion of the general subject.

Among those who have more recently written upon this subject, I know none who have observed so accurately, or described so clearly, the phenomena of the decomposition of the rocks in place, as Prof. C. F. Hartt, in his recent work on the Geology and Physical Geography of Brazil. Prof. Hartt, however, finds evidence that in many of the cases which he has described the decomposed rock is now covered by drift. This is not the case in the instances which I have observed in North Carolina; but the decomposed material remaining in place forms a covering over the solid rocks, averaging at a low estimate twenty-five or thirty feet in depth, even among the hard granitic rocks. Comparing with this the very small amount of disintegration which has taken place among similar rocks now exposed near the surface in the Drift regions, the conclusion seems unavoidable that *the time which has elapsed since the drift period must be very short compared to the ages during which these solid rocks were undergoing decomposition by chemical and atmospheric agencies.*

It may fairly be inferred that the rocks of eastern New England were, before the Glacial Period, decomposed and disintegrated to a very great depth; and thus the immense amount of material constituting the glacial drift of this region may be accounted for.

Prof. Shaler has shown that the mass of the drift materials must have been "rent from the floor of the glacier as it moved along,"[1] since the vast extent of the ice sheet precludes the notion of anything like lateral moraines He does not, however, controvert the generally received theory that the mass of the drift material has been produced by the mechanical action of ice in grinding and wearing away the solid rocks.

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[1] See Proceedings of the Boston Society of Natural History, Vol. XIII, p. 199.

If we accept the glacial theory of the drift, we have to consider the effects that would be produced by a great ice sheet passing over a surface like that here described. It is evident that if in the first part of its course the mass of ice cut its way down to the solid ledges, sweeping the decomposed material before it, the vast amount of this material would soon form a mountain ridge that must impede its progress; and the ice being the lighter material would be lifted from the surface and pass over and leave beneath it a great portion of the decomposed mass.

If, according to the most probable theory, the glacial climate came on gradually, and in each successive year the ice sheet extended farther southward, the annual advance and retreat would still fail to sweep the ledges clear of decomposed materials, except in the highest and most exposed situations. Valleys and ravines, especially in protected situations on the southern slopes of hills, instead of being excavated to a greater depth, would become filled with the materials of the terminal moraine, and these might remain undisturbed by the ice subsequently passing over them. The great bulk of the material would not be carried forward and deposited near the southern limit of the glacier's extent, but would remain beneath the ice, to be gathered and thrown into ridges during the retreat of the ice sheet as a whole, at the close of the glacial period.

The boulders of decomposition that have been referred to, the fragments of quartz from veins, and all undecomposed masses of rock in the material swept forward, would of course be more or less worn and changed in form; but the rounded forms of many of the larger boulders of the drift may, as we have seen, be accounted for in another way. The concretionary structure which has been referred to as determining the form and size of boulders, is, I believe, more common in the crystalline rocks than has been generally supposed, though the frequent occurrence of this structure is a fact recognized by the best authorities in geology.[1]

Boulders of decomposition produced by weathering, which takes place at first along the joints, have been well described by Professor Hartt, and no doubt the rounded forms are, in many cases, produced in this way, independently of any thing like a concretionary structure. This is especially the case in rocks abounding in compounds of the protoxide of iron, which by their tendency to chemical change, aid in the rapid decomposition of the rock. But this explanation will not apply in the case of the large boulder-like masses of granite and sienite so abundant in North Carolina, nor to the boulders of similar rocks scattered everywhere over the soil in northeastern Massachusetts.

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[1] See Dana's Manual of Geology, p. 98.

The question will naturally occur whether the rocks throughout the region described in North Carolina may not have suffered decomposition to so great a depth, on account of some peculiarities in their chemical composition which do not exist in the rocks of the northern region referred to. To this it may be answered that many of the boulder-like masses show no more evidence of rapid change now taking place than those of similar character in the North; and that after removing the decomposed rock to a great depth, a solid granite is reached which appears as well fitted for building purposes as that quarried in New England.[1]

Moreover, the phenomena of surface decomposition are far too extensive over large areas, and among all kinds of rocks, to be attributed to any local causes or peculiarities in the chemical character of the rocks.

The conclusions which have been drawn from the facts observed, may be briefly summed up as follows: —

1. The time which has elapsed since the drift period must be very short compared with the previous ages during which the solid ledges were disintegrated by chemical and atmospheric agencies.
2. Boulders of the drift do not, in general, owe their rounded forms to attrition by glacial action, but while still in place, assumed these forms by disintegration and exfoliation.
3. Whatever the force or agency of the drift may have been, it did not produce the great bulk of the drift material by mechanical action in wearing and grinding down the solid rocks, but its chief action has been to carry forward and commingle the materials already disintegrated.

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[1] Further researches into the chemical character of these rocks, and the nature of the changes that they have undergone, are very desirable in connection with this question, and I am glad to know that facts similar to those presented here, have recently engaged the attention of our highest authority on questions of chemical geology, Dr. T. Sterry Hunt.

NOTES ON THE GENUS BDELLOSTOMA. BY F. W. PUTNAM.

Since making the remarks on *Myxine*, at the last meeting of the Society, Professor Agassiz has very kindly placed at my disposal the specimens of the allied genus *Bdellostoma*, which were obtained by the Hassler Expedition at Talcahuano, Chili, about the middle of April, 1872.

These specimens were captured by the same means used by Professor Agassiz in collecting *Myxine* in the Straits of Magellan, showing that the habits of the two genera are very similar. There are about two hundred specimens in the lot, and all of nearly the same size. The smallest one is thirteen inches in length, and is a female with minute eggs; the other specimens are about twenty inches in length.

The general shape and anatomy of *Bdellostoma* is the same as that of *Myxine*, as will be seen by the specimens and dissections on the table. The cartilages of the head are more developed, so that the parts composing the singular cartilaginous framework can be better made out. There is also a slight difference in the ovary and in the peritoneal outlet, and a modification of the branchial apparatus.

The difference in the branchial apparatus of the two genera is at first sight apparently greater than is really the case when the structures are compared. In *Myxine* there are six branchial sacs on each side, each sac having a direct communication through its inner wall with the œsophagus, from which it receives water, the water being passed out by a duct leading from each sac to the single external opening on the side of the abdominal line; each lateral series of sacs sending ducts to the external opening on its respective side.

In *Bdellostoma cirrhatum*, from the Cape of Good Hope and New Zealand, which is the species so admirably dissected by Müller, there are either six or seven sacs on each side which receive water directly from the œsophagus, as in *Myxine*, but the emptying ducts, instead of passing backward and downward to a common external opening, as in *Myxine*, pass directly through the wall of the body, and thus there are as many external openings opposite the gill sacs on each side as there are sacs. In *Bdellostoma polytrema*, the species to which the specimens from Chili belong, there are ten sacs on each side, and each sac opens directly through the walls of the body as in *B. cirrhatum*. So that in this character the only difference between *Myxine* and *Bdellostoma* is, that the ducts in the former are elongated, all on one side leading to the same opening, while in the latter they are short and pass directly through the body wall, each for itself.

In *Myxine* the duct leading into the end of the œsophagus has its external opening close by the side of the left branchial opening, and passes in front of the heart to the œsophagus. In both species of *Bdellostoma* this duct also passes in front of the heart, and its external opening is close by the last branchial opening on the left side, thus occupying a position still further removed from the median line of the abdomen than in *Myxine*.

In *Myxine* the branchial artery passes from the heart forwards along the under side and between the branchial sacs, giving off right and left branches as it passes each sac, each branch passing over the sac and entering it about in the centre of its posterior surface in close connection with the duct leading from the gill.

In *Bdellostoma cirrhatum*, from Cape of Good Hope, figured by Müller,[1] the branchial artery has the same course as in *Myxine*, but divides into a right and left branch after supplying the three pair of sacs nearest the heart, each branch giving off smaller branches to the sacs of its own side. In *Bdellostoma polytrema*, from Chili, I have in *seventeen* specimens found the branchial artery to be divided into right and left trunks to its very base, and each trunk immediately turns off to its respective side, crossing the first three sacs in its course, and passing along the under edges of the rest, giving off branches from its upper surface to each of the sacs.

Owen mentions that in a specimen of *B. cirrhatum* the artery was divided to its base, but he does not mention the region from which his specimen came, nor the number of the gill sacs, and he may have had a Chilian specimen of the genus. It will be interesting to ascertain if this division of the artery is constant and characteristic of the Chilian species.

In *Myxine* the base of the long tongue is at the anterior branchial sacs, and in *Bdellostoma cirrhatum*, with its six or seven pair of gills, the same is the case, while in *B. polytrema*, with ten pair of gills, the tongue passes down between the first six or seven pair, and has its base in front of the next pair, leaving but three or four pair between the end of the tongue and the heart.

In *Myxine* the eggs are developed along the free edge of the ovary, which extends as a fringe as the eggs increase in size, and the eggs of several stages of growth are always at the free edge. In the Chilian *Bdellostoma* the ovary, even when the eggs are very minute, is developed as a broad band, and the eggs occupy a considerable portion, at least one-half, of the distance from the free edge, the large or mature eggs only extending from the walls of the ovary and forming the fringe.

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[1] Under the name of *B. heterotrema*, Abh. Akad. Wissensch., Berlin, 1834. pl. VII, fig. 3.

In *Myxine* the peritoneal outlet is single, and behind that of the intestine, and there is a small opening in the membrane over the terminal portion of the intestine, which allows communication from both sides of the intestinal canal with the peritoneal outlet. In the Chilian *Bdellostoma* this internal communication does not exist, but there are two peritoneal outlets behind the anal opening, affording direct passages from each side of the intestinal canal. The opening on the right side, which is the side occupied by the ovary, is larger than the other, and the left opening in *Bdellostoma* and the passage over the intestine in *Myxine*, are probably simply for the purpose of furnishing a passage for such eggs as may get pushed under the intestine to the left side.

From this comparison of the details of the principal points in the anatomy of these two genera, it will be seen that all the modifications are very slight, and will not warrant the separation of the genera into distinct families, as proposed by some authors, simply from the difference in the position of the gill openings. I therefore agree with Dr. Günther in retaining both genera in the family Myxinidæ.

As was the case in *Myxine*, so in *Bdellostoma*, have I been unsuccessful in finding a specimen that is unquestionably a male, though in one specimen there are no eggs developed, and in place of the wide ovary there is a simple tube that here and there contains masses of cellular matter, much more developed posteriorly, which has the appearance of a testis. With this exception all the large lot of specimens are undoubted females with the eggs in various stages of development, the same as noticed in *Myxine*. In several specimens the eggs are all very small, in others there are from fifteen to twenty that are much larger than the rest in the ovary, and in still other specimens the development of the egg case has commenced on the large eggs, and the first formation of the hooks at the ends of the egg are seen as granulations, while in still other specimens, in which the large eggs are from an inch to an inch and a quarter in length, the red color of the case can be seen at each end of the eggs, showing the formation of the horny case developing from the ends to the centre.

In one of the jars containing a number of the fishes that were very much decayed, I found among the mass two eggs which were probably just ready to be laid when the fish was caught. These eggs are one inch in length, and one-half an inch in width, and the anchor-shaped hooks, of which there are about eighty at each end, are about one-tenth of an inch in length. At about one-fifth of an inch from one end of the egg case is a slight lip or groove round the case, into which the substance of the egg itself projects, so that on taking the egg from the case, a corresponding ridge is seen round its surface. The egg case is of a beautiful red color, quite tough, and of about the thickness of good writing paper; over its surface are a large number of minute granulations, which are made by projections of points of the shell leaving corresponding pits on its inner surface. On holding the empty case to a strong light and looking with a lens from the inner side, the base of the hooks can be seen to be arranged in four irregular rows round each end, and each hook has its base in a small depression from the outer surface.

That all this complicated development of the egg and its membranes, and the formation of the horny case, with its granulations and projecting hooks, should take place in the delicate and thin membranous sac forming the ovary, and without the slightest trace of any glandular structure, is most remarkable, when we remember the complicated system of glands that is required to bring about the same structure in the development of the membranes of the egg and its case in the oviparous sharks and skates. This is still more instructive if we recall the fact that the next higher form of fishes above the Myxinoids are the Lampreys, in which the eggs are small, thousands in number, and laid without being protected by cases.

We thus have in the Myxinoids, the lowest form but one of all Vertebrates, a peculiar character in the formation of an egg case, and in the small number of eggs developed at one time, which is lost in the very next family above it to reappear, under a different mode of development, in the Selachians, a group in every respect structurally far above the Cyclostomes.

In regard to the use of the hooks on the cases of the eggs of Myxinoids, I believe that they are not so much for the purpose of attaching the eggs after they have been excluded, as they are for holding the eggs together in a chain when dropped from the ovary into the abdominal cavity, and thus aiding in their exclusion; as it must be impossible for the eggs to be loose in the abdominal cavity without being united by their hooks; for, on gently floating two eggs together, their hooks united immediately with such tenacity as to render it almost impossible to separate them without destroying some of the hooks, and if thus united in the abdomen, when one was excluded the rest would be obliged to follow, and the muscles of the abdomen would also act along the whole chain in the effort of exclusion.

The groove about the end of each egg case is probably a further provision, in this most perfect structure, to allow the young fish to make its escape from its tough case, and it will probably be found that the absorption of the case takes place at this point, the end dropping off like a cap at the proper time.

SPECIES OF BDELLOSTOMA.

Bdellostoma cirrhatum Günther.[1]

Head (measured to last gill opening) about one-third of total length, and contained about one and one-third times in length of abdomen. Tail contained nine times in the total length. *Base of tongue between the anterior pair of gills. Gills six or seven on each side.* Length, 34 inches.[2]

Habitat, "South Africa; New Zealand; ? Japan." (Günther.)

Bdellostoma polytrema Girard.[3]

Head about one-third of total length,[4] and contained about one and one-half times in the length of the abdomen. Tail contained seven to eight times in total length. *Base of tongue between the seventh or eighth pair of gills. Gills ten on each side.*[5] Length from 13 to 22 inches.

Habitat, Coast of Chili.

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[1] I have assumed Dr. Günther's synonymy, and with him question the habitat of Japan for this species.

[2] These proportions, length and characters, are derived from the figures of Müller. The number of lingual teeth I consider as of generic value. Günther gives 12 or 13 to the outer row, and 11 to the inner in *B. cirrhatum.* In five specimens of *B. polytrema* I found 13 in the outer row and 12 in the inner. In another specimen I found only 12 teeth in the outer row, but the last tooth in the outer row is very small, and only developed in old specimens.

[3] This is unquestionably the species described by Lacepède, under the name of *Le Gastrobranche Dombey*, and figured from a stuffed skin of a specimen collected by Dombey in Chili, but I do not see any more reason for adopting a French name than a common English name, and the law of priority must certainly be limited to a proper expression of the binomial system in scientific language. I have therefore adopted the name bestowed by Girard.

[4] In a specimen only thirteen inches long, the head was not quite one-third of the total length.

[5] Girard gives the gill openings as fourteen on each side, but it is very probable that a few of the mucous pores were counted as Dr. Günther suggests.

The Rev. Mr. R. C. Waterston gave an account of the habits of the Prairie Dog (*Cynomys ludovicianus*). A living specimen which Mr. Waterston had brought to exhibit to the meeting could not, unfortunately, be induced to leave his nest; some excellent figures were, however, shown.

The Secretary read the following extracts from a letter communicated by Prof. Jules Marcou: —

St. John, Newfoundland, Nov. 10, 1873.

My Dear Sir: — The following account of a remarkable marine monster, which made its appearance off the shores of this island, and of a severed arm or tentacle of the same, now in my possession, will I dare say be interesting to you, and also to Prof. Agassiz, to whom I should like to offer it.

On or about the 25th of October last, while a man by the name of Theophilus Picot was engaged at his usual occupation of fishing, off the eastern end of Great Bell Island in Conception Bay, his attention was attracted to an object floating on the surface of the water, which at a distance he supposed to be a sail, or the *débris* of some wreck, but which proved upon nearer inspection to be endowed with life. Picot, on observing that the object was alive, to satisfy his curiosity pushed his boat alongside, and I believe struck at it with an oar or boat-hook, whereupon the creature's fury seemed to be aroused, and it struck at the bottom of the boat with its beak, and immediately afterward threw its monstrous tentacles over the boat, which probably it might have dragged to the bottom had not Picot with great presence of mind severed one (or more) of the tentacles with his axe. A part of this tentacle or sucking arm I have now in my possession, immersed in spirits. I send you with this letter a couple of photographs of the said tentacle, and a few of the small denticulated sucking cups, all of which I hope will reach you safely.

Picot represents the body of the animal to have been about sixty feet long, and its general diameter as not less than five feet. The breadth of the tail he represents as at least ten feet. He states that when the creature found itself mutilated it made off backwards, or tail foremost, after the manner of squids, darkening the water over a large space with inky emissions. The enormous proportions given above might appear to be exaggerations, were they not to a great extent borne out by the fragment of the animal which was severed, and of which the photograph will give you a fair idea. The tentacle measured on the 31st of October, when I first saw it, after it had been several days in strong brine, and shrunk in consequence, seventeen feet; but was said to have measured nineteen feet previously. When it was first landed at a place called Portugal Cove, in Conception Bay, and within nine miles of St. John, some six feet was cut off the inner end of this arm, and Picot asserts that the original incision was at least ten feet from its articulation with the body. Accordingly the whole length of the arm must have been from thirty-three to thirty-five feet. The beak of the creature Picot described as being about the size of a six gallon keg.

The Rev. Mr. Gabriel, now residing at Portugal Cove, but who formerly resided at a place called Lamalein, on the south coast of the island, states that, in the winter of 1870 and 1871, two entire cuttle fish were stranded on the beach near that place, which measured respectively forty and forty-seven feet.

The man Picot says he saw the animal very distinctly for some time after it had been mutilated, swimming stern foremost with its tail above the water's edge, and that its general color was a pale pinkish, resembling that of the common squid.

The following is an exact copy of the memoranda I made on first inspecting this remarkable tentacle on the 31st of October. The total length of the fragment from the last incision to the extremity, seventeen feet. The extremity of the arm or terminating two and one-half feet is flattened, and somewhat in shape like a narrow paddle, tapering toward the end to a sharpish point. The thickest part of this terminal appendage is about six inches in circumference.

The inner fourteen and one-half feet is rounded in form, varying in thickness from three and one-half to four inches in diameter, or about the ordinary size of a man's wrist. On what I shall call the ventral side of this fourteen and one-half feet, there is a set of small tubercles or mammillæ which, at the end nearest the articulation, are about two feet apart, but become much closer and more numerous towards the extremity. Some small valve-like sucking denticulated cups are distributed along the area near the tubercles.

At the extreme point of the paddle-shaped extremity, and also at its junction with the rounded part, there is a cluster of small denticulated sucking cups, each cluster containing from fifty to seventy individual cups. The smallest of these is not larger than the head of a pin. The broad paddle-like part between the two clusters is armed with a double row, twelve in each, of gigantic suckers, without teeth, each measuring about one and one-fourth inches in diameter.

The whole tentacle, as coiled up for the photograph, measured two feet, four and one-half inches on the longer diameter. The photograph is one-fourth the natural size.[1]

I am, my dear sir, yours very truly,

Alex. Murray.

The Secretary exhibited photographs of two volcanic eruptions at Colima, Mexico, also kindly communicated by Prof. Marcou.

Section of Entomology. November 26, 1873.

Mr. Edw. Burgess in the chair. Fourteen persons present.

The following communication was read: —

Description of a Monstrous Female Imago of Anisopteryx pometaria, with Remarks on the Pupa. By B. Pickman Mann.

On the 9th of November, 1873, I caught a female *Anisopteryx pometaria* Harr. descr., which has two aborted wings on each side, and has pectinated antennæ. The normal female is wingless, and has simple antennæ. In this specimen the right fore wing is about 6.5 or 7 millimeters long; a fraction of a millimeter thick at the base, and as far as the middle; dilated at the middle into a flattened spheroidal bunch; thence slender to the tip. The right hind wing is about 3 mm. long and 1 mm. wide. The left fore wing is about 3.5 mm. long, and 0.5 mm. wide. The left hind wing is about 4.5 mm. long, and nearly 1.5 mm. wide. All the wings are clothed with scales, and have somewhat the appearance of fur tippets.

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[1] A mutilated specimen has since been taken alive in Coomb's Cove, which perhaps is the same individual referred to in the letter. Its body is said to have been as large round as a hogshead, and ten feet in length; the long arms measured forty-two, and the shorter, six, feet in length. See Am. Nat., Feb., 1874, p. 122; and Sill. Am. Journ., Feb., 1874, p. 158.—E. B.

When I examined the pinned specimen, although it was still alive, the right hind wing was turned so that it pointed forward, and every time that I tried to push it into its proper position it sprang back. All the other wings point backwards, but could be moved. The wings could not have been of any use for flight.

The antennæ are fully 6 mm. long, possibly a little more. I counted in the left antenna fifty-one joints. Each of the joints bears upon each side a tuft of fine hairs 0.4 to 0.5 mm. long.

To make sure that this was a female, I pressed the body so as to cause the terminal segments of the abdomen to protrude. The anal opening was protected on each side by a narrow chitinous band, with regular outline, as in other females. There was no semblance of clasping organs, so far precluding the idea of hermaphroditism. On pressing the abdomen more forcibly I burst it, and dislodged some eggs. Other eggs which were forced out remain attached to the mass of viscera, and can be seen now on the specimen. These eggs are clearly similar to the well-known eggs of the species. I carried the fresh and living female to Mr. S. H. Scudder, who acknowledged that my observations were correct. The specimen is preserved in my collection (Written No. 3085).

On page 465 of Harris' "Treatise on Some of the Insects Injurious to Vegetation," edition of 1862 (page 335, 1841; page 362, 1852), Harris says that the chrysalis of the female of *A. pometaria* is "destitute of a covering for wings, which is found in the chrysalis of the males." I find a like statement in Riley's Second Missouri Report (1870), page 97, probably a quotation, although the main subject of Mr. Riley's article seems to be *A. vernata*.

On the 17th of June, 1872, I collected two or three varieties of larvæ descending from elm and apple trees, and undertook to raise one hundred and fifty of these larvæ to the imago state. I paid little attention to them for more than a year, at the end of which time I found in my jars one hundred and forty earthen cocoons and twelve excluded female imagos of *A. pometaria*, then erroneously called *A. vernata*.

I opened about 30 cocoons from one of the jars into which I had put larvæ of a certain description, marked in my collection No. 3057, and found among them but ten well-formed and undeveloped pupæ, for n most of them the imagos were out of the pupa-skin and dead. All the developed imagos which I determined were females. A few of the undeveloped pupæ were entirely misshapen, or partially de-formed. In each one of the well-formed pupæ (and in such skins of others as are capable of examination), the wing cases are fully developed externally, even to such a point that in all which I examined for the purpose, six or more, I counted the eight veins of the wings as ridges, and distinguished the fifth or intermediate vein as arising from the discal nervure. Yet it was evident that there were no wings under the cases in some, at least, because in them I could see the sutures between the abdominal rings showing through the wing cases. Five of the pupæ thus examined vary in length from 9 mm. to 7 mm., and in breadth from 4 mm. to 3 mm., or from the largest to the smallest of all the pupæ which I extracted.

I carefully removed the dry and brittle pupa-skins from five of these pupæ, under the microscope, and found no wings beneath the cases. I opened the bodies of the five imagos extracted, and found eggs in each, so there can be no doubt that these are females. Harris' saying, therefore, if I understand it, is erroneous.

I extracted three well-formed and undeveloped pupæ from the jar in which the larvæ of the other description had been put, marked No. 3058, and found besides some dead imagos in some of the cocoons. All the imagos are wingless females, which are mainly, almost uniformly, of one size, and on the average much smaller than the imagos of 3057, but I see no characteristic difference between the two. The wing cases of these are fully developed externally, like those of No. 3057. Pupæ from 7 to 6 mm. long, from 4 to 2.5 mm. broad. I made sure that these are females by the same tests as used before.

I have placed the emptied cocoons and the others, as well as the extracted imagos, pupæ, and pupa-skins, in my collection, with name and numbers corresponding, and will gladly verify my observations by exhibiting the specimens.

Mr. S. H. Scudder called the attention of the Section to a Hesperian, in which ocelli were present.

In a memoir published in 1831 by the Berlin Academy of Science, Klug has reviewed the families of insects in which ocelli are present. He states that they are wholly wanting in the rhopalocerous Lepidoptera, even in the Hesperians, and this assertion has been received up to the present time. But in the male of the *Papilio Accius* of Smith-Abbot a single ocellus is found in the middle of the front, consisting of a slight eminence as broad as the base of the antennæ, smooth and lenticular; in the female, however, this eminence is divided into three minute points, which together are of the same size as the single elevation of the male; this seems to show that the male ocellus is formed of three elements united.

In all the heterocerous Lepidoptera which possess ocelli, these are two in number, and are placed one behind each antenna, probably therefore on the vertex. This difference is not extraordinary, for among the Hemiptera some groups possess ocelli below, some above the eyes, a difference still greater; while in other groups they are wholly wanting. In the genus Larema, to which *Papilio Accius* Sm.-Abb. belongs, two other species have been examined, *L. Pattenii* and *L. Hianna.* In the male of the former (the only sex examined) the ocellus resembles perfectly that of *L. Accius*; but there is not the slightest trace of ocelli either in the male or female of the latter; nor do they exist in the neighboring genera, so far as these have been examined.

December 3, 1873.

The President in the chair. Fifty-five persons present.

The following papers were read: —

Evolution of the Arietidæ. By A. Hyatt.

My researches continued during the past fourteen years upon the Ammonites of the Jura, but more especially upon the family of Arietidæ, have led to the following results.

The parent form of the family, which includes the genus or group Arietes, of Von Buch, and the series to which *Scipionianus* belongs,[1] is the species known as *planorbis* in England, and *psilonotus* in Germany.

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[1] This, however, does not include the group of *Amm. angulatus*, *Charmassei*, *Leigneletii* and *Boucaultianus*. These, by their young and adult forms, are distinctly separable from any of the true Arietian forms. The young have a stout, smooth whorl, followed by a stage in which the ribs are developed, and pass continuously over the abdomen. In the next stage the sides become flatter, the ribs on the abdomen divided by a channel, and in all the forms except *angulatus* or *catenatus*, the involution is notably increased. In the first old age stage the ribs again become confluent on the abdomen, and in the last stages almost or entirely obsolete. This stage compares in form and all its characteristics, with *Boucaultianus*, the last representative of this special series.

Catenatus and *angulatus* occur at Lemur with *tortilis* immediately above *planorbis*, and below the Angulatusbed. *Angulatus* with *Charmassei* and *Leigneletii* in the Angulatusbed, *Charmassei* continuing on into the Bucklandibed, succeeded by *Boucaultianus* in the Tuberculatusbed of Oppel.

In tracing the different series of species, it has been found that the forms differ in their adult characteristics, sometimes very decidedly, and in other instances hardly any definite line can be drawn between those of the same series. Thus Arnioceras, comprehending forms as distinct as the *miserabilis* of Quenstedt, and the *Ceras* of Giebel, may be described as one species; again *torus*, *tortilis*, *Liassicus* and *Nodotianus* are all distinct forms, and yet undoubtedly derivatives of the common stock, *torus*. It would be entirely ridiculous to describe the latter series as one species, but the former can be for the most part included under the name of *Amm. falcaries* Quenstedt. The difference is explained by the study of development.

Leaving out the first, or egg stage, common to all Ammonoid forms, and the Goniatitic, or second stage, common to all the Ammonites proper, the subsequent, or smooth stage, in *Arnioceras miserabilis* and its derivatives, occupies a notable proportion of the umbilical whorl, and has a peculiar form resembling that of the adult *planorbis*. The adult characteristics are slowly and methodically added after this stage of growth. Some individuals barely attain the form common to the genus; others, however, reach beyond this, and add by growth channels, and otherwise modify the form. In all cases, however, no sudden changes are made by the growth; each adult passes through a normal course of development, and the different characteristics distinguishing this or that variety or species, is gradually acquired, no abrupt changes being remarked.

In Caloceras, however, while all the young forms resemble *torus*, there is great latitude in the assumption of the adult form and characteristics, and differences, even in forms which must be regarded as varieties of the same species, are introduced suddenly during the later stages of growth.

The study of the adult individuals in Arnioceras would enable an observer to unite them, perhaps even into one species, as Quenstedt and others have done, and the study of the young would lead to a parallel result; but in Caloceras, while the consideration of the adults alone would lead to the distinction of numerous species, the investigation of the development alone would indicate here, as in Arnioceras, only one species.

Throughout the Ammonoids, we find everywhere instances of these two methods, the slow accumulation of differences, according to the

Darwinian theory, and their quick or sudden production, according to the law of acceleration, as explained by Cope and the writer, and subsequently by Mivart. The gaps between forms or species, may be largely explained by the latter mode of development, if the necessary care is taken to study the earlier stages, which should show the close genetic connection of the distinct adult forms, and explain thereby the absence of the intermediate varieties. By carefully observing these principles, it is possible to trace the entire family of the Arietidæ to one variety of one species, the smooth variety of *Psiloceras planorbis.*

The species are evolved from this single form in series of various kinds, some forming lines passing up through the various subsequent formations from the planorbisbed, giving origin in their turn to other series, and some remaining single.

Thus the whole picture is comparable to a genealogical tree, the trunk represented by the smooth *psilonotus*, which originates in the Triassic formation, and giving rise on either side to a fan-shaped array of branches, each branch representing a series of forms or species, and quite often having smaller branches of its own. In each case the point of origin of the branches or series is near the point of origin of the branch from which they spring, whence the fan-shaped arrangement alluded to above. Farther, each series perfects or carries a certain series of characteristics common to itself, and a certain series common to the whole family.

The first distinguish it as a genus or group, and the latter are the parallel or mimetic characteristics which are regularly produced in each individual, and each series, according to the place of the individual in the series.

Thus *psilonotus* is smooth throughout life, Arnioceras is smooth for a certain period in the young, then adds ribs, and a keel, then channels. The adult *Conybeari* adds tubercles on the ribs, which appear in a young stage of Coroniceras, a later appearing series, and then in the last number of its own series becomes more involute; this greater degree of involution appearing as a young characteristic in the last series of the family Asteroceras.

The old age changes observable in *psilonotus* are very slight, they become greater and more distinct in Caloceras, and succeeding series; finally in the last members of the series of Coroniceras they seriously affect the entire form of the adult, and in Asteroceras the adult of

Collenotii has precisely the same form as the old *Coroniceras trigonatum* or *Asteroceras obtusum*, and is also smooth.

Thus we have the common characteristics of the family produced independently, and in distinct series one after another in regular order in the species of each series, first in the latest member of the Conybeari series, then in the Arnioceras branch, again reproduced in Coroniceras, a descendant branch. Then reduced to a young characteristic, and finally abandoned, together with the channel and the form of the whorl and ribs which were also first elaborated in the adults of the Conybeari series, and Arnioceras, and replaced by characteristics which have first made their appearance in the old age of these very species themselves.

Thus the whole group may be compared to an individual taken out of either the highest and latest occurring member of the lower branch, Conybeari, or out of the centre of the Arnioceras branch, in Coroniceras. These have in each individual a smooth stage, or *planorbis* stage, then the adult with keeled, channeled, ribbed, tuberculated stage, followed by an old age in which all of these disappear, and the whorl becomes smooth, the sides convergent, the abdomen narrow and acute.

The young, therefore, compares with the adult of *psilonotus*, the adult possesses the characteristics elaborated by successive additions in the growth of the species which intervene between the individual and the point of origin of the series to which it belongs, and the old age points out the changes which must subsequently take place in its own series when the climax of development is reached, and the series is declining.

In other words, a series of species has, like an individual, a certain store of vital power which enable it for certain periods, more or less prolonged, to evolve new forms and new characteristics, but which in the end fails, and in place of farther progress in that direction we find an evolution of degraded forms, which compare exactly with the retrograde metamorphoses of the individual.

Size, which indicates vegetative growth, and the power to take in and assimilate large quantities of nutritive matter, which is usually called vital power, corroborates the above.

The size of the individual increases from *psilonotus*, which rarely exceeds four or five inches, to *Conybeari*, which attains the enormous diameter of over three feet.

Again, in the Arnioceras branch, the first appearing forms are very small, only an inch or two in diameter, and steadily increase to *Coroniceras trigonatum*, sometimes two feet in diameter, and then decrease in Asteroceras gradually to *Collenotii*, which again hardly exceeds two inches.

The individual grows by constant addition of characteristics, or parts, and declines by the loss in those characteristics or parts, first of the power to perform their functions, and then by their obsolescence. Series of species, on the other hand, progress by the evolution of forms which, in their adult condition, add certain common or parallel characteristics in regular order, and then decline by the evolution of a series of forms exhibiting the obsolescence of the same parts or organs, each form inheriting at an earlier age the old age characteristics of the parent until finally none of the adult characteristics remain even in the young.

OBSERVATIONS ON THE FOOD AND THE REPRODUCTIVE ORGANS OF OSTREA VIRGINIANA, WITH SOME ACCOUNT OF BUCEPHALUS CUCULUS NOV. SPEC. BY JOHN MCCRADY.

During the year between September, 1868, and September, 1869, I had frequent occasion to examine points connected with the natural history of *Ostrea virginiana* in Charleston, S. C. The specimens examined were almost all what are known there as Millpond Oysters, and are grown under circumstances very similar to those depended on to produce the "green oyster" of the European markets. One especial feature of this mode of culture is that the animal is fattened upon a mud bottom, where it remains imbedded so as usually to be invisible in the thick layer of low organic forms, carpeting the whole surface of the mud in unbroken continuity, wherever this mud is found. This organic layer therefore covers many square miles along the coast of South Carolina alone, and furnishes the exhaustless supply of food upon which the oysters fatten. The layer itself, whenever I have examined it, seems to consist chiefly of a yellowish organic film, which upon microscopic examination, presents the appearance of a sort of endless convoluted frill attached everywhere along one border, and free along the other: the convolutions in their natural healthy condition presenting somewhat the aspect of the upper surface of *cumulo-stratus*. In this frill, which indeed seems to constitute the whole organism, which I shall provisionally call *Chthamoctistes cumulus*, I could never make out any structure. It presented the appearance of a uniformly homogeneous organic film, in which irregular striæ often showed themselves apparently due to the convolutions, and the transparency of the film. The exception to this uniformity, which I observed, was the normal and regular existence of granules or nuclei, usually with a disposition to form clusters, and which on one occasion, at least, I observed to be liberated (apparently by the dissolution of the surrounding film), and which then appeared as a swarm of dancing cellules with something like a Brownian movement. Upon the layer of *Chthamoctistes cumulus*, the particles of mud brought by the tide are continually depositing themselves, so that it is slowly undergoing burial by this constant accumulation. Never, however, is this burial complete, for it grows upward as fast as it is buried, and if the mud beneath the layer be examined, the presence of Chthamoctistes may be traced downward to a considerable depth, mixed with a constantly increasing proportion of mud, so that it is impossible to say exactly where the deposit of mud begins in such a section, or where the traces of Chthamoctistes disappear. Indeed, my observations led me to conclude that the whole mass of these mud banks bordering the southern estuaries, would prove to be made up of a sort of organic framework furnished by the endless convolutions and furbelows of Chthamoctistes, with its instertices gradually filled in by constantly deposited mud particles. As the deposit grows, the superincumbent weight increases, the healthy and normal appearance of the Chthamoctistes ceases to be traceable in the lower parts, and the mud appears then more compact, but still contains traces of organic life in the form of granules and apparently detached pieces of the endless Chthamoctistes frills.

The upper healthy portion of the Chthamoctistes growth is tenanted everywhere by Diatoms and sporules of Algæ in countless numbers, and in less quantity by various forms of Rhizopoda; and all through the mud beneath, the lifeless shells and skeletons of these organic forms are found in abundance. Many examinations of the alimentary canal of the oyster prove that it is the Diatoms and spores of Algæ which constitute its food. The former, especially, are found perfect, or nearly perfect, in the stomach and anterior portion of the intestine, and, as empty skeletons, compose nearly the whole mass of the rejectamenta found in the rectum. A few Rhizopods now and then are found, and also a few antherizoids, which latter do not appear to suffer any diminution of vitality in the stomach and anterior portion of the intestine.

Reproductive Organs.

Though my attention was directed specially to the subject of the fertilization of the ova in the oyster, I was never able to procure any light on the subject. Davaine was similarly unsuccessful in *O. edulis.* His determination, however, that the oyster is hermaphrodite was fully borne out by my observations; which all tended to show that the male organ consists in every part of a solid branching stem, consisting wholly, as far as I could ascertain, of spermatocysts; and that this stem was everywhere completely surrounded and enclosed by the ovary, consisting usually of a granular common yolk-mass, in which are scattered at intervals everywhere germinative vesicles of various sizes, and with no enclosing membrane, so that they may be broken up by pressure into fragments which immediately each assume the spheroidal form, and then appear only as germinative vesicles of a smaller size. The spermatozoa are developed, or begin to be developed, and assume their perfect free form often long before the ova would be considered, according to the analogy of other animals, as ready for impregnation, that is, while they are still only scattered germinative vesicles everywhere enclosed in a common yolk mass. The spermatozoa may be seen in their aggregated, or even their free condition, actively moving about among masses of this granular yolk-substance enclosing many germinative vesicles, without exhibiting any attraction for them, and without the appearance of any change in the young vesicles themselves. The spermatozoa have, as described by Dr. Burnett, an ovo-globular head and a delicate tail, which I did not succeed in tracing but once to its extremity, and which always seemed to me rather short.

The ova were observed by Davaine in a subsequent condition, in which they were no longer simple germinative vesicles embedded in a common yolk mass, but a condition in which each such simple vesicle appears to be surrounded by a separate yolk of its own. But he was unable to ascertain whether or not the egg of the oyster ever presents the ordinary form among animals, viz., a vitelline membrane enclosing a yolk, within which are found a germinative vesicle, containing a nucleus, or nucleus and nucleolus. Nor did he succeed in discovering whether, as in other Acephala, the ova ever became enclosed each in a separate and usually pyriform sac of the ovarian membrane.

I was fortunate in having the opportunity to observe the ova in both of these advanced conditions, as well as in that which Davaine observed; and there is also recorded among my notes an observation upon an old oyster in which, notwithstanding the absence of any observable germinative vesicles, the yolk had undergone its regular segmentation into distinct yolk masses; while a young oyster examined at the same time contained similar perfectly separated yolk masses, each surrounded by a vitelline membrane, and containing a very distinct simple germinative vesicle (but without nucleus or nucleolus), easily separated from the yolk. This observation may mean that oysters become sterile so far at least as the female products of the generative organs are concerned, with advancing age.[1]

In reference to these more advanced stages of the egg in the oyster, not hitherto observed, so far as I am aware, by any one, I prefer to give an extract from my journal of observations written at the time of observation.

"Examined to-day (April 23, 1869) a good-sized mill-pond oyster. It was quite lean, and the shell whitish, but it had the black mantle and the yellow color. It was opened immediately after being taken out of the water of my aquarium and the heart was beating at

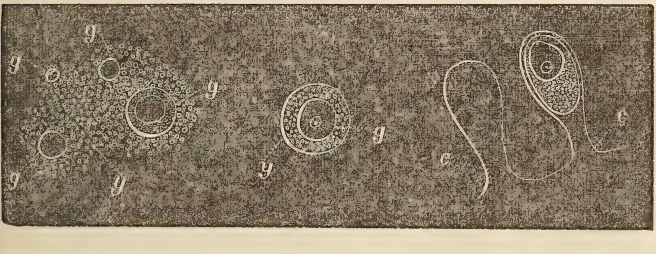

Fig. 1.

Egg of *O. virginiana* in various stages.
g, germinative vesicles. *y*, yolk. *c*, egg-capsule.

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[1] In such a case we may, however, suspect the possible existence of a Parthenogenesis. There is no known reason why yolk-mass should not in all cases be germ-mass, and of the nature of a bud, capable under favorable circumstances of developing into a new individual; but ordinarily overcome and assimilated as food by the superior vitality of the embryo, resulting from the contact of the spermatozoa with the germinative vesicle. This seems to me the direction in which we should look for the explanation of such Parthenogenesis as appears to exist in the female Bee.

the rate of nineteen or twenty pulsations a minute. This is much more than the rate of beating observed in oysters which have been some time out of the water, in which there are long intervals of rest between the beats.

"The examination of the ovary proved very interesting, for I found numerous ova, all provided not only with germinative vesicle, but with one or more Wagnerian vesicles, and these often containing a dot. This is quite different from Davaine's results, as he never was able to establish the existence even of the Wagnerian vesicle at any point of the growth. Moreover, the ova were lodged in distinct pyriform sacs, precisely as is usually the case in other Lamellibranchiates, and of this also Davaine makes no mention. The shape of these sacs was precisely that of a Florence flask, and the neck quite long. One view in profile was accidentally obtained, showing clusters of these pyriform ovisacs standing out from the membrane of the ovary.

"It is quite impossible that there should be any error as to the existence in this case of the Wagnerian vesicles, as they were much larger than the yolk cells, and of a quite different appearance, being seemingly mere specializations of the substance of the germinative vesicle, and like it quite transparent. The dot within these Wagnerian vesicles appeared to be a congeries of granules.

"I endeavored next to ascertain whether or not spermatozoa were present, but could not satisfy myself on this point, as my eye had become fatigued, and no disposition I could make of the light enabled me to discover whether the minute dancing cellules, which were quite numerous, had or had not a tail."

This observation makes it evident that the egg of the oyster does pass through a stage in which it has an ectoblast, mesoblast, entoblast, and entosthoblast, like other ova, and that it also, like the ova of other Lamellibranchiates, has a stage in which it is lodged in a distinct pyriform saccular diverticulum of an ovarian membrane. This latter point was confirmed by several other recorded observations, in some of which the sac existed, though the germinative vesicle contained neither nucleus nor nucleolus.

I am therefore led to doubt the conclusion arrived at by Agassiz in the case of *Tubularia* (*Parypha*) *cristata*, where there is a similar obscurity, that in that case the ovum passes into the embryo without the intermediation of a stage characterized by the ordinary complication of structure.

The egg of the oyster, therefore, appears to pass through the following phases.

1. A phase in which there are only germinative vesicles embedded in a common mass of yolk, exhibiting no differentiation into distinct yolk masses.

2. A later phase, in which each germinative vesicle has appropriated its proportionate share of yolk, which gradually becomes surrounded with a vitelline membrane.

3. A phase still later, in which each complete ovum may consist of ectoblast, mesoblast, entoblast, and entosthoblast, and is lodged in a distinct pear-shaped ovisac, attached by its narrow and rather elongated neck to an ovarian membrane.

4. Spermatozoa have been observed to be present in the ovary at every one of these stages, without the appearance of any of the phenomena of impregnation. It must, however, be here remarked that the only observation of the spermatozoa in the ovisac phase was in a specimen in which there was neither nucleus nor nucleolus recorded as observed in the germinative vesicles.

It is evident that the evolution of perfect spermatozoa antedates that of perfect ova, though these former may continue to be seen in the reproductive organ up to the time when the ova have nearly reached maturity.

The spermatozoa may be seen in an active state when the ova are as yet scarcely determinable. Again, we cannot affirm that at the stage of actual maturity of the ovum, any spermatozoa are present.

The case is still further complicated by the fact that in the climate of Charleston the spawning time of the oyster seems to extend from May to November, the spawning being heaviest from about the middle of June to the middle of September. At almost any time during the summer it is possible to find individuals with very immature ova.

It remains a question, therefore, whether self-impregnation is not actually barred by some not yet known provision, and whether the spermatozoa are not freely discharged into the water to be wafted to other individuals, whose ova may be ready for fertilization. The closely gregarious and crowding habits of the oyster render this altogether possible, and in cases where the sexual products have flowed from a tumid generative organ on pressure by the finger, I have observed at one time the extrusion of ova only, at another, the extrusion of spermatozoa only.

Bucephalus cuculus nov. spec.

In total ignorance of the observations of von Baer upon *Bucephalus polymorphus*, and of those of Lacaze-Duthiers upon *Bucephalus Haimeanus*. or that Claparède had observed what was probably an advanced freely swimming stage of the latter species, in July, 1868, I found in the oysters of Charleston a closely allied entozoon. My observations, though not sufficiently detailed to be of any great interest, nevertheless probably indicate at least a new species, and are, I believe, the first record of this remarkable entozoon in America.

On the 23d of July (1868), I examined six oysters as to the condition of their reproductive organs. My journal records that only one of them was in egg; two others being plentifully supplied with spermatozoa; while the remaining three, including the largest, had their reproductive organs filled in every direction with a peculiar parasitic growth. As soon as I opened the organ I was struck with the white fibres brought up by the knife, as something I had never seen before. With the microscope I soon ascertained the presence of various stages of the development of a vermiform larva, provided in its most advanced form with two long tentaculiform organs at one extremity, the portion to which they were attached being distinguished from the rest of the body by a marked constriction. The cavity within the body was very evident, but no evidence could be obtained that even in the most advanced form it extended to either extremity. The part bearing the tentacula was not only separated by a marked constriction from the body, but seemed to be provided with lip-like folds, such as frequently appear at the oral extremity of the gastrostyle of a Hydroid Medusa. The opposite extremity of the body was truncated, and I observed some appearances which I thought might be due to the animal's attaching itself by this truncated extremity, and behaving like a hydroid larva, lengthening and shortening its body, the lower parts of which could be considerably elongated.

Round embryos, like the outline, fig. 1, were observed, but in this instance these were detached from the others, and it could only be surmised that they really were the youngest stage of the same animal. The outlines 2, 3, 4, and 5, and one representing the same stage as fig. 6, were satisfactorily traceable to the cysts, where they were observed to be enclosed usually three in the same cyst.

Six days after (July 29), I found another oyster infested by the same parasite; my notes represent the generative organ as filled with the fibres found in the previous examples. These were more particularly examined and proved to be nodose branching tubes, recalling forcibly the branching stems of Hydroids, being occupied like them by a fleshy parenchyma enclosing a canal, *d* (except in young branches, like fig. 8, *e*), and expanding at irregular intervals into

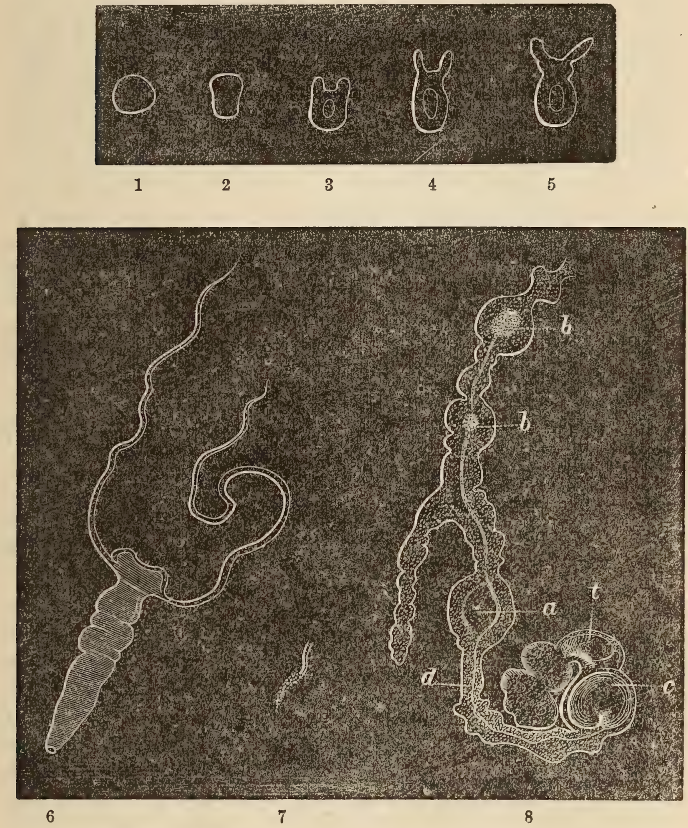

Fig. 2.

1–8, stages in the development of *Bucephalus cuculus*. 7, extremity of tentaculum. 8, sporocyst. *a*, apparent cavity. *b*, opake nucleus. *c*, already formed worm with tentacula *t*. *d*, central canal. *e*, young branch without canal.

round ovoid, or ellipsoidal chambers. These chambers sometimes exhibited what seemed to be a mere cavity, formed by an enlargement, as at *a*, of the central canal, sometimes to have this cavity filled with an opaque nucleus darker than the other parts, as at *b*. In no case did I observe any contractility, such as would have been involved by the formation of these narrowings and widenings of the tube under the microscope. Indeed, the impression left upon me by the distinct resistance of the tubes to the knife was that they would probably prove chitinous. The species, therefore, is, in respect of the rigidity of its tube, more in accord with the observations of Baer and Siebold upon *B. polymorphus*, than with those of Lacaze-Duthiers upon *B. Haimeanus.* Again, as at *c*, would sometimes be seen a worm far advanced in development, and in the larger ellipsoidal cysts were several still more advanced stages. I was, however, prevented from continuing the observations; and this will account for the meagreness of detail in the drawings marked 7 and 8, of which the former represents a worm liberated by the breaking of the tubular stems during removal. My journal records that the tentacula are remarkably long and extensile, and that they appeared bristling along their whole length with pointed cells, having a general resemblance to lasso-cells, but that I could find no appearance of a lasso either within or without these cells. I have no recollection of a ventral aperture or sucker, and my journal does not even allude to any feature of appearance which might be so interpreted. Of course I do not consider this conclusive that there was none, and I have therefore abandoned the generic name (Hydricuculus) I had given to the parasite, and have assigned it to the genus *Bucephalus* von Baer.

Meagre as are these details and drawings, they appear to me to indicate quite a distinct species from *B. Haimeanus.* The younger stages show a proportion between the size of the budding tentacula and that of the body, quite different from what appears in the drawings of Lacaze-Duthiers. These tentacular buds are much shorter and stouter in proportion, and the body also stouter and shorter than in *B. Haimeanus.* On the other hand, the advanced larva, fig. 7, seems to be considerably narrower and longer than the other species, and its tentacula shorter. This difference, however, may be due to age. Though I observed fine transverse striations, the more distinct constrictions of the animal's outline presented to me none of that regularity indicated by Lacaze-Duthiers. They seemed to be mere irregular contractions of the body wall at different points, no one of which extended completely round the body.[1] The only permanent transverse constriction I observed was that separating the tentaculiferous extremity from the rest of the body. Finally the rigidity of the tube seems to separate this species from *B. Haimeanus*, and to approximate it to *B. polymorphus*; an approximation borne out by the presence of those bodies in the tentacula which reminded me of lasso-cells; something like which seem to be present in Baer's fresh water species, but not in the *B. Haimeanus*, though the latter, like our *B. cuculus*, belongs to the sea, and is found in the oyster (*Ostrea edulis*) of Europe, as *B. cuculus* is in *O. Virginiana.*

The appearance of the oysters infested by this parasite is precisely that described by Lacaze-Duthiers. Instead of the creamy or yellowish tint of the healthy ovary, this part of the animal, on removing the shell, seems covered by a transparent tissue, beneath which are seen indistinctly the branching tubes, which in this position have rather a brown appearance, and do not appear white, as they seem when removed from the organ. According to my observations, the whole generative organ is filled by the branching growth of this sporocyst, but I did not observe the parasite in any other part of the body. Moreover, in such oysters, though not specially sickly in appearance, and only less fat than their healthy companions, I did not find any trace whatsoever of either ova or spermatozoa; and I understand the presence of this parasite as completely destroying, for the time at least, the fertility of its victim. It is quite conceivable that the years of short spawn, said to be frequently noticed by those concerned in oyster culture, may be due to unusual abundance of these parasites in those years. I had no means of ascertaining whether the parasite proves fatal to the oyster. As I have said, no very distinct signs of sickness are observable. Of the oyster, from whose reproductive organ the parasites sketched in figs. 7 and 8 were taken, I find the following remark in my journal, "This oyster was taken out of the mud yesterday morning" (July 29th, time of writing), "and stood all day and all night upon my microscope table without water, but in the shade." In the summer of Charleston this is a severe ordeal for a healthy oyster, yet the next sentence records: "His heart was beating, and he seemed in pretty good condition notwithstanding this treatment. He was not, however, so fat as many of the oysters are even at this time, and an examination of the generative organ found it filled with the fibres" of our parasite. It must be borne in mind, however, that the standard of comparison here is the degree of fat usually retained by healthy oysters in summer, and this is far below what they exhibit in winter. On the whole, all oysters may be said to sicken during the time of reproduction, and I do not think that the individuals I have found thus infested, could be said to be much more sickly than they would have seemed from the effects of their own reproductive processes. In the one case they seem to give their winter's gain to the development of their own offspring, in the other, to this cuckoo-like worm. In all probability the oyster is completely freed from its intruding guest before the winter sets in. Such fibres, in such number, if introduced with an oyster into the mouth of man, would probably soon make themselves known as something very different from the oyster itself, and yet I have never heard of their being noticed in winter, notwithstanding the enormous consumption of these animals as food. The fact also that Claparède found a Bucephalus (which he identifies with *B. Haimeanus* under the name of *Cercaria*[1] *Haimeana*) on the coast of Normandy, between the middle of July and the end of September, freely swimming in the sea by means of exceedingly lively strokes of the long appendages, which I have called tentacula for want of a better name, seems to indicate that in the latter part of the summer these parasites abandon their temporary abode in *Ostrea edulis* and *Cardium rusticum*, perhaps to seek another; as even in this more mature condition, Claparède found no traces of sexual organs, and but little advance upon the simple structure figured by Lacaze-Duthiers. My own observations were all made in the latter part of July. I do not find any record of the time of Lacaze-Duthiers' observations.

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[1] By an error in the woodcutting, one of the constrictions in Fig. 6 does appear to be continuous across, but this is not the case in my original drawing.

In its free condition Claparède several times found this Bucephalus attached to the underside of the disks of Sarsias and Oceanias, and in one instance, probably by some accident, the long tentacula had been lost. He saw, however, nothing to indicate that the Medusæ furnished for it more than a temporary harborage.

In *Mnemiopsis Leidyi*, A. Agassiz has frequently observed "a long flesh-colored, cylindrical worm, with five longitudinal white lines extending the whole length; the mouth by which it is fastened to the jelly-fish (to the inner wall in the upper part of the long furrow, near the eye-speck) occupying the whole of the anterior part. This mouth can be closed, extended to a point, and when inserted in the substance of the jelly-fish, it is expanded again like the mouth of a trumpet, and the worm is firmly fastened." These worms, he tells us, are sluggish in their movements, and exhibit only slow contractions of their bodies when detached, though they will live several days after being separated. He cannot refer them to any of the genera described, though he regarded them as resembling a leech more than anything else.

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[1] Pagenstecher asserts that these larvæ are not true Cercariæ, and that while a Distoma may develop from their body, their tentaculiform extremity develops anew into a germ-sack. I know not on what facts this statement rests. I quote it from Cobbold's Entozoa, p. 30, having not yet seen Pagenstecher's "Trematoden und Trematoden-Larven."

It is curious that the only jelly-fish I have observed in the pond where these infested oysters were bred, was the *Mnemiopsis littoralis*, whose development I traced in 1857, and described under the name of Bolina. But they were taken in the month of April, and no parasites of any kind were observed upon them; nor have I observed *Bucephalus cuculus* in any later stage of growth than that described in this paper. The great size of A. Agassiz' worm (its length varying from an inch to an inch and a half), and its five white lines, are very unlike the parasite of the oyster. But the Cercariæ, to which group of larval forms Bucephalus belongs, appear to be all young of Trematoda, and in our ignorance it is well to bring into comparison with each other all the facts we can collect.

GENERAL REMARKS.

The remarkable fact that in the case of Bucephalus the "sporocyst" is a branching stem, in which is formed a continuous canal, has, so far as I am aware, no analogy, except among the Hydroid Medusæ, and some Polyzoa and Tunicata. Among the Hydroids, the ciliated embryo, as in Melicertum, according to A. Agassiz' observations, sometimes simply elongates into a worm-like shape, enlarged at one extremity, and enclosing a simple cavity of nearly the same form as the embryo. By the enlarged extremity these embryos attach themselves, and continue their growth, sometimes even put out lateral buds before the formation of a polyp-head. Here, therefore, we have an embryo in the form of a branching stem with central canal, and soon clothing itself with stiff chitinous sheath. In other Sertularians, and the case which I recall was, I think, an Obelia, a colony may, according to my observations, throw out from its stem a multitude of long branches without polypheads, evidently, according to my interpretation, in consequence of conditions unsuitable to its ordinary mode of sustentation and growth. The long branches thus thrown out seem to be efforts to secure a more suitable location; and usually, according to my impression, do not appear unless the polyps are in a sickly or dying condition. The fact seems to indicate that the branching stem of the Sertularian is really the persistent embryo, or planula become arborescent. In this state it normally produces by gemmation polyps which remain in sarcocœnonia, if I be permitted the term, with the ramifying embryo; and in Antennularia and Aglaophenia, as Allman has shown, the ramifying embryo also produces in the accessory cellules, rhizopodous sarcode extensions of its substance, containing lasso-cells; whence it is easily conceivable that by these alone the embryo might capture and digest its food; while in Hincks' genus Ophiodes, these accessory bodies take on a remarkable development so as to present the form of tentacula, capable of varied movements. Prof. Allman even advocates the view that the palæozoic Graptolites are the horny stems of such nematophorous, polypless embryonic forms, and his view is worthy of most attentive consideration. However that may be, the facts forcibly indicate that among the Sertularians the branched polyp stem, with its numerous and often annular articulations, is a branched vermiform larva, capable of independent existence under favorable circumstances. And this interpretation is supported by the phenomenon of frustulation, which also we owe to Allman, and which is probably the complement of that development of long branches observed by myself in Obelia, or an allied genus. In this case the cœnosarc of the long branch transversely divides itself spontaneously into small frustules resembling planulæ in all respects except the want of cilia. These next escape from the ruptured extremity of the chitinous sheath of the branch, find new places of attachment, and without being themselves metamorphosed, give out buds which develop hydroid polyps at their free extremities. So that the embryo is still capable of multiplying itself by a process peculiar to itself. We may doubt, therefore, whether the stems of the Tubularians are indeed always strictly homologous with those of the Sertularians. They are frequently produced from a polyp already formed; and it is singular that similar frustules observed by Allman in Corymorpha, actually developed directly into polyps, instead of producing the polyp through the medium of a bud.

My own incomplete observations upon *Bucephalus cuculus* left me under some doubt whether in that case, as in the Hydroids, there was not actually a frustulation of the entire contents of the sporocyst, in the production of the more advanced stage. The more definite observations of Lacaze-Duthiers seem, however, to settle the question that the process is one of internal gemmation, and this coincides with what is observed in other Cercarian forms. Nothing of this kind has been observed among Hydroids, unless we admit the case of supposed "Allœogenesis," contended for by Haeckel; in which he regards the young Cunina as budded out from the columella of Geryonia, upon which they are found. Notwithstanding my recognition of Haeckel's great abilities, and his extremely valuable labors as an original investigator, I cannot admit his interpretation of these observations. It is impossible to imagine that a remarkable form like Cunina should be developed by gemmation, both from a Turritopsis and a Geryonia; and that notwithstanding there should be no more than a specific difference between the Cunina from the one, and that from the other; and nothing proves more forcibly the profoundly disorganizing tendency of the Darwinian view of an indefinite and practically lawless tendency to variation and transmutation, than that so able an observer should propound such a view of the facts in this case. There is, in my opinion, no evidence from the observations of Fritz Müller and Haeckel, that there is any gemmation at all. The fact observed by both appears to be that the very youngest form of the larval Cunina is a very small planula, which adheres so closely to the epithelium of the stomach of its host, as to appear merely as a thickening of that membrane. When, as a beginner in embryological research, I made the mistake of supposing the parasitic Cunina larvæ to be young of Turritopsis, I was misled by the analogy of Tubularia nursing its own embryos, but corrected my mistake in the later stages of my research. That Prof. Haeckel can imagine my first interpretation more correct than my second, I can only explain as one of the miracles wrought by the hypothesis of transmutation. Not only is the budding of one sexually mature form from another and a different sexually mature form, a thing so contrary to what we know of development, and so unparalleled by all our observations as to require incontrovertible proof before it could be accepted, but the assumed fact depended on for proof in this case, namely, the origination of an animal as a bud from the mere thickening of a mere epithelium (an already quite highly specialized structure) is equally unsupported by all we know of development, and utterly incongruous with the known processes of gemmation among the Hydroid Medusæ.

But the fact that Cunina is, during its larval existence, a parasite, deriving its nourishment from the stomachs of other Medusæ of various forms, various genera, various families, and even various orders, such as Aegina, Liriope, Carmarina, and Turritopsis, and taking such positions either within or without the stomach, as will render it possible to procure the food there elaborated, is important as multiplying the evidences that parasitism is not confined to any particular class or group of special animal forms; and that we must recognize not only parasitic Insects and Arachnida, parasitic Crustacea, parasitic Gasteropoda, parasitic Worms, and parasitic Actiniæ, but that the habit of parasitism is not even foreign to the class of Acelephæ. Parasitism is indeed the universal condition of finite existence.

The special connection of this discussion with my present subject is, that the analogies of Bucephalus with the Hydroids, remote as they are, have led me to reflect that Leukart's Cœlenterata have been very much neglected in the general movement of recent systematists to revive the simple classification of our ancestors, and to incorporate all the low forms of animal life in the all-embracing group of Worms. The typical Hydra itself is remarkably vermiform, and so also are many Ctenophoræ, and there is not a single Acaleph or Polyp which is not equally or more vermiform than any single Echinoderm. Yet the naturalists, who have not been deterred by the enormous difficulties of the case, from favorably entertaining Huxley's proposal to associate the Echinoderms with the Annelides, have not hesitated to leave the Cœlenterata behind. But certainly the movement in question cannot be complete until the great sub-kingdom of Worms has absorbed into itself not only the Annelides, Rotifers, Gephyriæ, Platyelminthæ, Nematoda, Polyzoa, Brachiopoda, Tunicata and Echinoderms, but these much overlooked Acalephæ and Polypi. These last are not only fully as vermiform as the Echinoderms, but the Hydroids and Discophoræ have, in their planula form and its modifications, a vermiform embryological basis, which has no radiate characters. There is a stage more or less vermiform, succeeding the egg stage, in nearly all animals. Well marked indications also of bilateral symmetry have been pointed out by various observers throughout the groups of Polypi and Acalephæ. The general absence of an anus is no objection, for besides the differentiation between the trumpet-shaped tube and the remainder of the ordinary oral-ana opening, which we see in Siphonactinia, and less distinctly in Cerianthus, we must recollect that many Platyelminths and some Nematodes are similarly deprived of an anus, and that the former, in many points of their structure, recall the type of organs seen in Acalephæ though they present this type in a highly differentiated condition.

The group of Vermes, even as generally received, and excluding the Echinodermata, appears to me a heterogeneous collection of remarkable forms, some of which can hardly be said to have any close homologies with the others, and to agree with them in little else than a general vermiform appearance, and the possession of some similar structures, which may prove to have no closer relations with each other than the arms of Brachiopoda with the gills of Fishes, or the fin-like organs of Loligo with those of Amphioxus. The Annulata or Annelida and Rotatoria have the closest affinities with the Arthropodous Articulates. The Gephyrian Vermes have undoubted and long recognized connections with the Echinoderms, and these, with embryological considerations, have induced Huxley to associate the latter with the Annulata. But there is another view which may give quite a different result without separating the Gephyrians from the Echinoderms; I mean the view that the Gephyrians are an aberrant outlying branch of the Radiate, as the Cirrhipeds are of the Articulate, and the Chitonidæ and Dentalium of the Molluscan type. The very larvæ of the Echinoderms which have furnished the argument for associating the latter with the Vermes, have really very decided affinities with Ctenophorous Medusæ, as Agassiz claimed, and the typical affinities of the Acalephæ with Echinoderms are so close that any disposition made of the one group must eventually carry the other along with it.

Just as the Gephyrians probably constitute an aberrant group o Echinodermata, the Platyelminths (Trematodes, Turbellarians and Cestodes), may constitute another such aberrant group with more or less affinities with the Acalephæ, especially the Ctenophoræ. The question whether Cuvier, mistaken though he was as to the true affinities of the Polyzoa, the Rotatoria, and most of the other organisms included in the provisional group of Infusoria, had not, nevertheless, a more just conception of the limits of the morphological possibilities of the type which he not very happily named Radiata, than his successors, is yet an open one; and a thorough discussion of it must be had before we can accept the Vermes as anything but a provisional group, very similar in character to that popular classification by which all low forms of animal life are included together as worms or vermin.

Before associating all vermiform animals together, in a single group, we ought to recollect how great an obscurer of typical character is Parasitism; Mimicry being an extreme illustration.

Parasitism is indeed the universal condition of all finite being. All animals and plants known to us are parasites of the earth; but many are, besides, close parasites of other animals and plants, and all animals and plants are, in the large sense, parasites of other animals and plants. Sexual union should be regarded as a form of temporary parasitism, marriage as a permanent form of parasitism. Many organic forms also live attached to other bodies, whether organic or inorganic; others live beneath the earth in caves, or in the soil, mud, rock, or wet sand, as burrowers, either freely, or in structures formed by their bodies for protection; all these, though forms of parasitism upon the earth, are very different from those other forms of parasitism upon the earth, in which the animal moves freely upon or above the surface of the ground, either through air or water. We find, moreover, that when an animal has, at one period of its existence, habits of parasitism very different from those affected by its nearest allies, that then it differs more or less from the morphological norm of its nearest allies during the same period. The young Starfish, which enjoys a free existence in the sea, as a wandering geoparasite, during its larval stage, develops the complex and remarkable structure of Brachiolaria or Bipinnaria; while other, and even closely allied species, which pass the same period, as parasites upon their mother, or attached to foreign bodies, develop nothing but obscure rudiments of this Brachiolarian organism; and pass more or less directly into the form of the starfish. The subject itself is capable of cosmical development. In the Animal Kingdom many other examples might be adduced, did space permit; among them I may notice the peculiar structures developed by young placental Mammalia, in consequence of their parasitism upon the womb of the mother; as well as the corresponding structures developed by the mother in consequence of the same parasitism, which otherwise sometimes leaves impressions of a permanent character upon her organization, so that all her offspring are apt to resemble the first born. These structures developed by the female mammal are strictly comparable as effects of parasitism to the galls developed in plants, in consequence of the parasitic presence of insect ova; and to the cysts formed by the tissues of animals, in consequence of the presence of entozoa. In fact, all parasitism may be considered as bi-polar in its effects, though often the effect on the one or the other party, is inappreciable. The variability of animals and plants under *domestication* is due to the addition of a form of parasitism upon man, which we call *domestication*, to their ordinary geo-parasitism; and we have no right to infer from this, equal variability in their ordinary state, unless we can show equal change and variability of parasitic conditions. It is change of parasitism which induces change of structure; as we see in the cases of the Lernæans, the Cirrhipedia, Dentalium, and the Gasteropod parasite of Synapta, among many others; and I believe that if animals have, in the course of their genealogical history, undergone great modifications of form, they have done so in consequence of great change from one kind of parasitism to another widely different. The consequent change of structure may have had a suddenness, comparable to that of the metamorphosis of an insect, or may have been more gradual, according to the rate of change in the conditions of parasitism. If, moreover, the change of parasitic conditions were geographic, the consequent change of structure might include a whole fauna, involving the sifting action of "Natural Selection."[1] If the change embraced the whole earth, the structure of all animals and plants would have been affected simultaneously.

But especially it is to be noted, that while these changes of structure may be very extraordinary, they have their limit. So far as we know, they never involve the *potentials* of the form changed, or the ratios of these potentials to each other; that is what I may call the *Logos* of the form. What is subject to modification is not this Logos, but the relative degree in which its various potentials may be realized. Especially the generative system, though subject to functional disturbance by great changes of parasitic conditions, is not thereby transmuted into a new generative type. No true sexual bar seems to be thus produced between allied lineages.

Now all Trematodes are zoo-parasitic, *i. e.*, parasitic upon other animals, and we should expect in their case a wide departure from the form of their nearest allies among merely geo-parasitic animals. I do not hesitate therefore to compare the Trematodes with the Radiata in general, but especially with Echinoderm larvæ, more especially with

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[1] Which is only one of the *modus operandi* of Organisis, and has nothing to do with Evolution, or with the Origin of Species.

Brachiolaria (as we know its history from the admirable research of Alexander Agassiz), and with such Acalephæ as the Ctenophoræ and Æginidæ. The so-called caudal appendages of Bucephalus and the Cercariæ, including two stumpy lobes, or long tentacula, one on each side of an intermediate lobular unpaired organ, I compare with the *anterior* extremity of Brachiolaria, which in the early stages of that larva is its *posterior* extremity. The unpaired lobe, especially, is developed into a long flat tail in the next stage of growth, like the anterior projection of Brachiolaria, and the long streamers of Bipinnaria. The warty adhering organs on this anterior projection of Brachiolaria (which is also trifid, like the caudal extremity of Cercaria) are probably homologous with the suckers of such forms as Polystoma, and are analogously used to anchor the larva while undergoing resorption into the young star-fish. The digestive system of the Trematodes would then require to be interpreted as in the condition of that of Brachiolaria, before the mouth is formed, and when the opening subsequently to be restricted to the functions of an anus, fulfils also those of a mouth. Possibly the ventral sucker of the Cercaria may be a specialization of the depression on the ventral surface of Brachiolaria preceding the formation of the mouth. But however that may be, this synthetic condition, in which a single opening fulfils at once the functions of mouth and anus, is precisely that which we see, not only in Turbellarians, but among all Acalephæ; more especially for our present purpose among Ctenophoræ, which not only bear their sense organs at the opposite pole, but in a large number of forms present two remarkable tentacula, which I compare with those of Bucephalus, and also (since they are lodged in special tubular chambers) with the single peculiar proboscis of the Nemertians. When the water-tubes are sprouting, as two horns, from the blind digestive tube of Brachiolaria before the mouth is formed, we have a condition of the digestive system nearly identical with the ordinary biramic form among Trematodes; while again the isolation of the water system from the digestive among Trematodes and Cestodes, is merely an advance in specialization upon the synthesis of the two systems in Ctenophoræ; we can still directly compare the one case with the other, for the single or double contractile vesicle and opening of the water system at a point opposite the mouth in Trematodes, Cestodes and Nemertians, correspond precisely in formation and position to the two contractile "cœliac apertures" of Ctenophoræ, so well figured and described by Agassiz, and which also have an excretory or depuratory office. Finally the hermaphroditism of Platyelminths finds itself repeated, though in a much less specialized form, among the Ctenophoræ.

The Planarians, which seem among Radiata to be analogues of Gasteropoda among Mollusca, though not parasites upon other animals, have a parasitism upon the earth involving habits wholly different from those of the Ctenophoræ, yet present a digestive system eminently similar in type to that of Ctenophoræ. Moreover, the water system in Cestodes, and among Trematodes and Turbellarians, both the digestive and water systems are, like the same systems in Echinoderm larvæ, Ctenophoræ, and all other Acalephæ, merely hollowed out in the solid body. All these forms indeed, as well as the Polypi, are Cœlenterata. The body cavity of Echinoderms seems to be a special modification of the right water-tube of the larva, and to be itself part of the water system. At any rate, such cavity here and among the Nemertians and Nematelminths is a mere specialization, and since, by general consent of naturalists, it presents no bar to the association of these animals with the Cœlenterate Planarians, it can present none to an extension of Leukart's Cœlenterata, so as to include in it all the Echinoderms, Gephyrians, Nematelminths and Platyelminths, and so to bring us back to the Radiata of Cuvier, emended of course by the elimination of Polyzoa, Rotatoria, pseudohelminths generally, and Infusoria.

The existence of a vascular system sometimes with pulsatile enlargements, among Echinoderms, Gephyrians, and Nemertians, is, like the body cavity, a mere advance in specialization. The usually close connection of this system, where it exists with the water system, points to its interpretation as a specialization of that system; which indeed, among Acalephs and Polyps, performs both functions.

Similarly I regard the highly developed nervous system among Gephyrians and Platyelminths as mere advances in specialization, which like the entire apparatus of spines, hooks, exsertile proboscides and highly developed muscular system, the external organs of generation and the existence of a true coitus, among the Helminths, must be attributed to the requirements of their modes of parasitism.

The Nematoda seem to be specialized upon the basis of the Cercarian form. At least that interpretation is suggested by the frequently lobed caudal extremity, which is sometimes bi-lobed or tri-lobed, as in Gordius and Pseudalius; while *Leptodera appendiculata* and *Filaria appendiculata* very strikingly recall Bucephalus in their caudal appendages. The great difficulty is presented by Sagitta: but here we have a Nematode with very extraordinary conditions of parasitism, which make it the analogue among Radiata of the Pteropoda among Mollusca. An extraordinary form therefore we may naturally expect, and find it no bar to the assignment of Sagitta to the same branch of the Animal Kingdom with which its nearest allies connect themselves.

On the other hand, the Annulata proper are undoubtedly, as Cuvier taught, members of the great Articulate series, having the distinctly arthro-cylindrical body, which is archetypal in that series. The same remark applies to the Rotatoria, which hold a position in respect of the Crustacea and Arachnida, analogous to that held by the Annulata proper to the Myriapoda and Insecta. The Leeches at the base of the Articulate series seem to be analogues of the Lampreys at the base of Vertebrata, and to have similar conditions of parasitism.

The approximation of the Gephyrians to the Echinoderms I have treated as a matter of course; their embryology is the same, but they differ in the parasitism of their adult condition. I include among them Balanoglossus and Phoronis, the latter being a polypoid form allied to the Sipunculidæ. The extraordinary variety of form and structure among Gephyrians, affords an excellent field for the study of the modifying effects of extraordinary conditions of parasitism.

The progress of real knowledge is not usually cataclysmal. A vague striving after the subversion of everything done by our predecessors, is as unscientific as an unreasoning acquiescence in their results. Cuvier showed good ground for the belief that there are four great groups presented to us in the Animal Kingdom. Our improved acquaintance with structure renders it not only necessary for us to adopt a fifth group, the Protozoa, either as a provisional or as a permanent arrangement, but tends constantly to convince us that Cuvier's four groups are not all equally disparted, the one from the other. It seems to me to prove that there is an affinity (which may lead to the establishment of an order of homologies) between the Radiata and the Articulata on the one hand, and between the Mollusca and the Vertebrata on the other; while at the same time that it approximates these groups two and two, it tends to widen proportionately the distance between the Radiata-Articulata series on the one hand, and the Mollusca-Vertebrata series on the other. Yet in no way does it tend to invalidate the existence of these four groups.

If, for example, we symbolise the Animal Kingdom by a great tree, of which the short but common trunk is, roughly speaking, the egg, or the earth, we may conceive in accordance with our present knowledge, this trunk as bifurcating into two great stems or subordinate trunks, diverging in opposite directions, each of which again divides into two great branches. Then we observe that though these two branches on each great stem are usually very distinct in their foliage, and that one stands on the whole altogether lower than the other, yet that their outmost twigs often so intermingle as to render it difficult to decide to which branch each belongs, and that actually we find the lower branchlets of the higher branch sometimes to hang lower than the highest branchlets of the lower. Nay, further, that in spite of the opposite divergence between the two main stems, there is an important, though disguised parallelism between their secondary branches, and that not unfrequently an aberrant branchlet from one stem appears to us as if it might possibly belong to the other, until embryology has traced it to its source.

By the important parallelism referred to, I mean the fact that the Radiata, the lower branch of one stem, and the Mollusca, the lower branch of the other, correspond with each other in the sacciform structure of their bodies, though they differ in the type and disposition of their organs; while at the same time the Articulata, the higher branch of the one stem, and the Vertebrata, the higher branch of the other, though differing in the type and disposition of organs even to direct opposition, so as to be antitropes, actually agree in the circumstance that in each case the body is arthro-cylindrical. And this parallelism involves a Paralogy or whole series of analogies between the two great stems.

Nor does the recognition of these differences in the least obscure the fact that the tree of life is one tree, the animal kingdom a unit, having for its origin the earth, which either was itself, or else contained the germ whence all organic types have originated, probably by fissiparition, in a manner analogous to the gemmation of polymorphic communities from a common embryonic stock, such as we see in Siphonophoræ, and many Polyzoa; but distinguished from such cases by the circumstance that the forms produced are all detached (instead of attached) parasites of their embryonic source, and also because their fissiparition must have been preceded by a peculiar differentiation of their common source, whence it results, that in reproducing themselves by sexual union, though the young begin at the egg (representing the earth) they do not, as the earth did, each develop all forms of terrestrial life, but are restricted, each, to the development of its own forms only; and, moreover, this primordial differentiation seems to have resulted in a *sexual bar*, rendering impossible the production of permanent intermediate lineages, though often admitting the production of sterile offspring (known as hybrids), between lineages closely allied in structure. Within its own limits there is ample evidence that each primordial form is susceptible of variation, often very great, but never without law, depending for the special form it assumes in each given case: 1, upon the invariability of its own *Logos* or specific ratio of potentials; 2, upon *Organisis*, involving the kind of its parasitism, and its changes from one kind of parasitism to another, necessarily accompanied by "Natural Selection"; and, 3, upon the Universal *Law of Development*, which involves both of the preceding principles, 1 and 2, and adds *Evolution*, by which the potentials of the integral origin are realized as phenomena, according to their ratios, in the Logos, in such wise that the Special and the General succeed the Homosynthetic: Evolution thus showing tself, as a progress from Homosynthesis to Heterosynthesis, from integration to disintegration, from what is "Organic" to what is "Inorganic"; having the integral for its limit of origin, and the elemental for its limit of progress; while between these limits development is capable of manifesting a vast variety of forms, restricted by the specific possibilities of the Logos, on the one hand, and by the specific actualities of Parasitism, on the other:[1] the maximum of variability being near the limit of origin, the minimum near the limit of progress.

The Origin of the "Tailed Man." By Dr. H. Hagen.

Perhaps the following short communication concerning the fabulous "tailed man," often mentioned in the last century, and even later, will be of some interest to the Society.

In endeavoring to copy from a number of old works the figures quoted as belonging to the so-called tailed man, the fact became gradually developed that they were all copies one from the other, either reversed or not, some of course slightly altered, until the tailed man was completed: the gradual modification produced in time the caricature.

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[1] These views are the development of those communicated to the Elliott Society of Charleston, South Carolina, May 15th, 1857, an abstract of which will be found in that Society's Proceedings, Vol. I, p. 222.

1. The original of all is *Simia* or *Macacus Silenus* of Linné, from Ceylon, rather badly figured by the old Knight Bernhard von Breydenbach, in the description of his voyage to Palestine, published in 1486. He was a brave but somewhat credulous man, without scientific knowledge.

2. The celebrated Conrad Gesner gave a reversed copy of Breydenbach's figure in 1551, as *Cercopithecus*, in his Liber de Quadrupedibus.

3. Ulysses Aldrovandus, the Italian Polyhistor, in his Liber de Quadrupedibus, Digit II, copied Gesner's figure (not reversed) in 1637, as *Cercopithecus raræ formæ.*

4. Linnæus, in his Anthropomorpha, in 1760, gave the same figure as *Lucifer* or *Homo caudatus.* In this figure, however, the inner part of the handle of the walking-stick, in the hand of the animal, is turned upwards. I believe that between Aldrovand and Linnæus there may probably exist still other copies unknown to me, and bridging over the gap between them.

5. The last copy is given by Buffon in 1788, as tailed man.

After the story of the existence of tailed men was once originated, it was often repeated without any change, or new proof by later observers. This tendency to figure monkeys with somewhat human features has appeared several times, as in the figure of *Simia Syrichta* Linné, from Luzon.

Perhaps the origin of other fabulous animals may be explained in the same manner; in the words of Condorcet, " Remonter à la source d'une erreur, c'est la réfuter."

December 17, 1873.

A special meeting of the Council of the Society was called by the President, on Dec. 15, and it was voted that the regular meeting, which should have been held on Dec. 17, be omitted, out of respect to the memory of Professor Louis Agassiz.

Section of Entomology. January 1, 1874.

Mr. E. P. Austin in the chair. Twelve persons present.

The following papers were read: —

NEW NORTH AMERICAN LEPIDOPTERA. BY H. K. MORRISON.

Family GEOMETRIDÆ.

Genus *Acidalia.*

Acidalia albogilvaria (sp. nov.).

Expanse 18 mm. Length of body 6 mm.

Head, antennæ, palpi and body, pure white. Anterior wings white, crossed by three distinct, wavy, ochreous lines, with two other fainter lines, which sometimes are only represented by costal spots or submarginal lunules. The first basal line is sometimes rudimentary, forming a spot on the costal margin, in some specimens extending faintly across the wings. The second is distinct, less wavy than the third, extending across the wings. The third and fourth lines are distinct, subparallel, broken into short waves between the nervules, much more marked than in the second line. They are distant about 1 mm. from each other, and 2 mm. from the second line. The fifth line consists of a faint costal spot, in some specimens prolonged into a faint interrupted submarginal line. Posterior wings above, with the third and fourth lines continued, distinct, slightly more regular than on the anteriors, extending across the wings. Fifth line represented by a few submarginal spots, sometimes combined into a faint line. First and second lines obsolete. Discal dots small, black, distinct, situated between the second and third lines, but not touching either of them; on the posteriors, situated before the third line. Anterior wings beneath white; discal dot larger than above, linear. Costal margin with ochreous spots and discolorations more conspicuous at the apex. Posterior wings beneath pure white, without discal dot. No traces of the ochreous lines on the under surface. Fringe long, white, concolorous.

Hab. Massachusetts, New York. In July. Collection of H. K. Morrison.

This species is allied to *Acidalia peralbata* Packard, from which it differs by the absence of marginal black dots on the anteriors, and by the different form and position of the lines; and also by the pure white of the wings beneath; only marked by the discal dot, and ochreous costal margin.

Acidalia cacuminaria (sp. nov.).

Expanse 22 mm. Length of body 9 mm.

Palpi and front black; antennæ and vertex dirty white; collar black. Body above and beneath uniform dirty white. Anterior legs in front black; behind whitish. The remaining legs white, with a black spot at the junction of the tarsi with the tibiæ. Abdomen with a row of dorsal black spots, one to each segment. Wings above shining, dirty white, with a very slight tinge of ochreous; irregularly sprinkled with black atoms. Anterior wings elongated, pointed at the apex. The extra-basal line represented by a faint black spot on the inner margin, and another, black, distinct, on the median nervure; the two are connected by a faint reddish brown line. This line is not continued to the costal margin, but stops at the median nervure. The discal dot black, distinct. The median shade is represented by an oblique, reddish brown line, commencing on the middle of the inner margin, and crossing the wing beyond the discal dot. This line is thickened on the inner margin, where it is most distinct, gradually becoming fainter as it proceeds, and ceasing shortly before the costal margin. It is much more oblique than is usual in this genus, and if continued would reach the costa a short distance before the apex. Beyond this line another, black, oblique, broadly undulating, extending to the apex. From the inner margin to the fourth median nervule it is continuous, from that point to the apex it is represented by small black dots on the nervules. Beyond this line a broad band, composed of black, irregular, poorly defined blotches; very conspicuous on the inner margin, and covering the inner angle, becoming gradually extinct before the first median nervule. There is a slight tinge of reddish brown between the larger of these blotches. A series of black, very distinct, marginal dots between the nervules, that between the submedian nervure and fourth median nervule being double. Posterior wings elongated; costal angle rounded. A very acute angle at the termination of the second median nervule. Between this angle and the costal angle the wing is deeply concave; from the marginal angle to the anal angle the margin is straight. Anal angle but little rounded. Abdominal margin nearly straight. Wings crossed by four undulating lines, interrupted by the nervules; all of which are more conspicuous on the abdominal margin. The first is a continuation of the median shade, reddish brown, passing before the discal dot, which is black, distinct. The second line is black, tinged with reddish brown, formed of dots on the nervules united together, and does not extend quite to the costal margin. The third is broad, undulating, formed of black, irregular blotches, distinct on the abdominal margin, gradually becoming fainter, but generally reaching to the costa. The fourth line is reddish brown, interrupted, parallel to the third, not extending to the costal margin. Three conspicuous marginal dots before the marginal angle, and three, sometimes four, less strongly marked between it and the anal angle. Wings beneath dirty white, powdered with black scales. Discal dots large, black, distinct. Median shade blackish brown, fainter than above, extending across both wings. Beyond this, on the anterior wings, a series of black dots on the nervules, as above. Beyond this line a faint gemminate black spot near the internal angle. Faint submarginal shades formed of united atoms. Marginal dots present, not so distinct as above. Posterior wings with a few faint shades corresponding to the lines above. These shades are united and more conspicuous on the abdominal margin a little above the anal angle, where they form a dark irregular blotch. The three marginal dots before the marginal angle present; the others sometimes obliterated. Nervules distinct after the median shade. Fringe concolorous.

Hab. Massachusetts, about the first of July. Collection of H. K. Morrison.

Can be recognized by the elongated wings, both anterior and posterior, by the acute marginal angle at the end of the second median nervule of the posterior wings, by the oblique lines, and by the conspicuous marginal dots.

Genus *Macaria*.

Macaria unimodaria (sp. nov.).

Expanse 22 mm. Length of body 9 mm.

Palpi beneath brown, lighter at the base. Front, vertex and collar, brown. Antennæ testaceous. Body ash-colored above, beneath lighter. Wings above uniform ash-color, powdered with numerous dark brown atoms. The markings brown, and with the exception of the exterior line, vague and indistinct. Anterior wings with the interior line curved, formed of dark brown points, larger and more distinct on the nervures. Median shade consisting of an ill-defined costal spot, with short branches extending along the subcostal nervure; another spot at the junction of the median nervure and fourth median nervule, and still another upon the submedian nervure. The spots are partially connected together by brown shades. Exterior line undulating, not reflexed on the costa, formed of quite clear and distinct brown spots on the nervules; it is closely followed by a faint whitish line. This line is followed by a broad submarginal shade. The shade is scarcely darker than the ground color, except on, and for some distance below the costa, and in the interspace between the second and third median nervules, where it forms dark irregular blotches. The submarginal shade is also followed by another faint whitish line. This line is more distinct opposite to the brown blotches. A series of faint marginal dots at the base of the fringe. The discal dot is included in the median shade. Posterior wings of a still more uniform coloration. Discal dot large, brown, situated in the median shade, which is broad, diffuse, but little darker than the ground color. The disc of the wing lighter, thickly sprinkled with gray atoms. Exterior line absent. Submarginal shade formed of segregated atoms of the ground color, suffused interiorly, edged exteriorly with a faint whitish line. Ground color beneath, whitish. Discal dots black, large. Anterior wings covered with brown spots and striæ. Interior and exterior lines, and median shade visible only in the centre, and on the internal margin of the wing, obliterated on the costa, which is ochreous with brown transverse striæ. Submarginal shade very diffuse, extending to the outer margin. Two faint submarginal whitish spots near the apex, and one in the interspace between the second and third median nervules. Posterior wings much lighter. All the lines obsolete, with the exception of the median and submedian shades. The latter is very distinct, brown, clearly defined exteriorly; diffused interiorly. After this shade the white ground color shows more plainly than on any other portion of the wings a series of brown dots at the base of the fringe, which are whitish, intercepted with brown at the termination of the nervules. Nervules on both wings fringed with orange-yellow.

Hab. Massachusetts, in July. Collection of H. K. Morrison.

This species belongs to the same section of the genus, and is very closely related to *Macaria ocellinata*, Guenée. It differs from it by its more uniform coloration, by the exterior line not being reflexed on the costal margin; and by the presence of faint whitish lines bordering the submarginal band on the anteriors. Beneath, it differs by the absence of the distinct, clearly-defined submarginal shade on the anterior wings, and the submarginal shade only is found on the posteriors; the exterior line is not present, as in *ocellinata*, where it forms with the submarginal two parallel distinct lines or shades.

Macaria sectomaculata (sp. nov.).

Expanse, 22 to 25 mm. Length of body, 10 mm.

Palpi, front and collar, dark yellowish brown. Abdomen and thorax concolorous with the wings, the former with two subdorsal longitudinal series of round black spots; beneath these on each side of the abdomen, another series of smaller lateral spots, sometimes interrupted. There are thus four spots to each segment. Wings strongly angulated. Anteriors with the apex subfalcate, beneath which the margin is deeply excavated, and then produced, forming a marked angle at the termination of the second median nervule; from this point the margin is almost straight up to the inner angle. Posteriors with an acute angle at the termination of the second median nervule. Wings profusely sprinkled with brown atoms and slightly tinged with ochreous; above dirty white. On the anterior wings the three ordinary lines are distinct, brown, subparallel, slightly undulating, reflexed on the costal margin, and there forming slightly diffused spots. The subterminal shade is represented principally by two brown, very conspicuous blotches; the first, immediately beneath the costa, is divided into three or four portions by a transverse line of the ground color and by the costal branches, which are white. The second, and most conspicuous blotch, is black-brown, situated at the divarication of the second and third median nervules and includes a portion of the exterior line, it is cut into parts by a transverse line of the ground color, which immediately follows the exterior line, and by the second and third median nervules, which are marked in white. The indentation below the apex on the outer margin is broadly marked with black-brown. Posterior wings with only two lines present. The exterior line is followed by a series of light brown blotches, divided by the nervules; discal dots indistinct. Wings beneath profusely sprinkled with blackish atoms. Median and subterminal shades and exterior line present, brown overspread with ochreous. Nervules tinged with ochreous. A series of black dots at the base of the fringe. Discal dots distinct.

Hab. Massachusetts, New York. In May. Collection of H. K. Morrison.

This species is of the size and general appearance of the common *M. quadrisignata* Walk. I have named it *sectomaculata* in allusion to its most distinctive character, the brown subterminal blotches, cut by the nervules and exterior white line.

Genus *Fidonia.*

Fidonia quadripunctata (sp. nov.).

Expanse, 21–22 mm. Length of body, 8 mm.

Palpi brown above, white beneath. Front, vertex and thorax clothed with intermixed white and brown scales. Abdomen, above and below, whitish with numerous brown atoms. Legs whitish, with tarsi alternated white and brown. Antennæ in the male pectinated, female simple. Ground color of the wings, pearl white. Anterior wings, with brown atoms (in addition to the brown bands) on the basal and costal regions. Interior line arcuated, dark brown, slightly irregular, situated in, and partially concealed by, an ill-defined band, composed of accumulated lighter brown atoms. Median shade, an irregular brown band touching the interior line in the centre, and separated from it on the costa and inner margin; faint yellow shades sometimes present along its course. Discal dot black, large, situated in the white median space. Exterior line very dark brown, slightly dentate, undulating, subparallel to the outer margin, followed and almost concealed by a broad, regular, brown, submarginal band; another marginal band, equally broad, separated from the first by a narrow band of the ground color. This band is narrow and regular in the male, broader and irregular in the female, and in the latter its central portion is occupied by a series of irregular dark brown spots. Nervules slightly tinged with ochreous. An interrupted dark line at the base of the fringe. Fringe dark brown interrupted with whitish yellow between the nervules. Posterior wings above white, with numerous brown atoms. Discal dot black, large. In the female the interior and exterior lines are present, ochreous, subparallel, distinct, with brown spots along their course; the submarginal dark brown spots are also continued on the posteriors. The brown marginal border is continued on the posteriors, but becomes obsolete before the anal angle. A brown line at the base of the fringe, which is white interrupted with brown. Wings beneath white, with numerous brown atoms. Nervules ochreous. Discal dots large, very distinct, equal in size on both wings. On the anterior wings the interior line is reproduced. The median shade and submarginal and marginal bands are absent. The exterior line is distinct, formed of brown spots on the nervules. In the female the submarginal row of spots is reproduced beneath, in the male it is absent or hardly perceptible. On the posterior wings the exterior and interior lines are continued, ochreous, with brown spots on the nervules. The submarginal spots are also present, more evident in the female. Fringe as above.

Hab. New York, Massachusetts. From June 1st to 15th. Collection of H. K. Morrison.

This species is closely related to *Fidonia bicoloraria* Minot, from which it can be distinguished by its smaller size (*bicoloraria* expands 27 mm.) The following additional distinctions exist between the two species. In *quadripunctata* the discal dots are very large and of equal size on all the wings, above and beneath; in *bicoloraria* the dots on the anterior wings are large, while on the posterior wings they are small, faint, often nearly obsolete. On the anterior wings of *quadripunctata* beneath, the exterior and anterior lines are present and very clearly marked; in *bicoloraria* only the costal portion of the exterior line is found, and that is sometimes absent. In *quadripunctata* the posterior wings above have the lines and submarginal spots more or less marked, the marginal band of the anteriors is also continued on the posteriors; in *bicoloraria* the posterior wings are only marked with the faint discal dot and with brown atoms. In *bicoloraria* the fringe of the posterior wings is immaculate; in *quadripunctata* it is interrupted with brown. The habits of the species are also different, *bicoloraria* I have found resting on the trunks of trees, only flying when disturbed; while *quadripunctata* is found with *truncataria* Walk. in dry, sterile, open fields, very difficult to capture and flying actively at mid-day.

One female, three male *quadripunctata* and six male, one female *bicoloraria* examined.

Genus *Hybernia.*

Hybernia olivacearia (sp. nov.).

Expanse, males, 32 – 35 mm. Length of body ♀ ♂, 10–11 mm.

♂. Palpi dark brown. Front whitish. Vertex and collar clothed with mingled black and white scales. Antennæ pectinated. Prothorax with a transverse black band. Thorax gray, with an olivaceous tinge. Abdomen lighter olivaceous gray, with a tinge of yellow, a series of transverse black bands between the segments; beneath light gray. Anterior femora dark brown. Tarsi of all the legs white and black alternating. Anterior wings above, gray, almost entirely covered with olivaceous spots and bands. Interior and exterior lines and median shade, black, very rarely forming continuous lines. Interior line curved, consisting of three black, ill-defined spots, on the costa, median nervure and inner margin, seldom connected together. Median shade consisting of spots arranged in the same manner as in the interior line; in one specimen this line is distinct and connected. Exterior line parallel to the outer margin, commencing on the costa, five-sevenths of the distance from the base to the apex and consisting of black spots on the nervules, sometimes partially connected together, terminating on the inner margin, very close to the median shade. At the termination of these two lines on the inner margin, there is frequently a gemminate black blotch. Two conspicuous, submarginal, parallel, dentate, olivaceous, bands, including one of the ground color. The first is the most strongly marked. These bands, or traces of them, are present in every specimen which I have examined. A series of marginal black spots. Posterior wings above gray, thickly powdered with olivaceous atoms. Discal dot present. In about one specimen in three there are traces of the exterior line, and in one in five or six the first submarginal band can be seen. A marginal black line. Fringe gray. Wings beneath smoky gray, with the lines above not reproduced. Anteriors free from spots. Posteriors sprinkled with dark atoms. Discal dot distinct on both wings.

♀. Antennæ simple, finely alternated with black and white. Head as in the male. Thorax and abdomen dark gray. Abdomen with two dorsal, longitudinal, black bands, enclosing one of the ground color. Two series of black spots along the sides of the abdomen; the upper one is only present on the middle segments. Wings rudimentary, 1 to 2 mm. in length, generally uniform gray. In one specimen the wings are 3 mm. in length, with traces of lines and spots.

Hab. Massachusetts. From April 20th to May 5th. Collection of H. K. Morrison.

Olivacearia is closely allied to *strigataria* Minot. (*Anisopteryx? strigataria* Minot). But there are two constant characters which will always separate the males of the two species. 1st. The olivaceous color of the wings, particularly the anteriors; in *strigataria* the wings are gray, without any trace of olive green. 2d. In *strigataria* the three black lines are always continuous and strongly marked; in *olivacearia* they are represented by black spots on the nervules, and although in several cases one of the lines is continuous, the others on the same specimen are disconnected and rudimentary. There are several other distinctions between the two, which are, however, not always constant. In *strigataria*, three lines on the posteriors above are nearly always present; in *olivacearia* there is very rarely more than one, and that is often absent. In *strigataria* the lines are partially reproduced beneath; in *olivacearia*, they are absent. In *olivacearia* the two submarginal bands of the anteriors form a constant and conspicuous feature; in *strigataria* there is seldom more than one present, and that is frequently vague and little marked. As I am not sure of the identity of my female *strigataria*, I cannot draw a comparison between the females of the two species.

Fifteen males, twenty-five females of *olivacearia*, and five males, one female of *strigataria* were examined.

Genus *Cidaria*.

Cidaria albo-punctata (sp. nov.).

Expanse, 32 mm. Length of body, 12 mm.

Palpi dark brown. Front, vertex and collar, light yellowish brown. Antennæ dark brown, becoming lighter at the tip; in the female simple, in the male the first two-thirds are pectinated, the last third simple. Body yellowish brown, sparsely sprinkled with fine black atoms. Ground color of the wings white, tinged on the costa, apex and submarginal region, with light yellowish brown. Anterior wings with the base covered with brown spots and striæ. A black diffused spot in the centre of the base, immediately adjoining the white sub-basal band. This spot is sometimes only represented by an accumulation of the brown striæ. Interior line black, very distinct, reflexed on the costal margin, then proceeding in a regular undulating curve, to the centre of the interspace, between the submedian nervure and fourth median nervule. At this point (in about one-half the specimens I have examined) a narrow white arm projects outwardly, about one-half of the distance to the exterior line; from this arm the interior line first curves inwardly, and then drops almost perpendicularly to the inner margin. The interior line is broadly bordered internally with white. In one specimen there is another narrow arm, situated in the discal space and extending towards the discal dot. Discal dot very large, white, conspicuous, partially bordered with black. Exterior line black, distinct, commencing on the costa a short distance before the apex. There are three acute projections on each of the costal nervules. From the third costal nervule to the inner margin, the principal feature of the line is two broad inward curves. The first is much the smaller, having two lobes; extending to the second median nervule, from the second to the third median nervule the line is nearly straight; from the third median nervule to the inner margin it forms a broad inward curve, consisting of three lobes, the central one being the largest, and nearest to the interior line. The entire central portion of the wings, between the interior and exterior lines, uniform brown, slightly lighter and with perceptible striæ on the costa. Exterior line, bordered externally with a broad white band. Entire submarginal region of the wings, beyond the white band, covered with brown spots and striæ. A subapical, darker blotch, situated on the border of the white band. Fringe dark brown, interrupted with whitish between the nervules. Posterior wings above (in all the specimens I have seen except one), without any trace of lines or discal spot. In one specimen the exterior line is quite visible in the centre of the wings. Numerous brown atoms, particularly near the outer margin. Outer margin and base of the fringe light yellowish brown. Fringe white, interrupted with brown at the termination of the nervules. Anterior wings beneath with the markings above partially reproduced, costal margin and apex more distinctly, yellowish brown. Posterior wings beneath, very thickly sprinkled with brown atoms. Exterior line present, distinct, brown, dentate, followed by a whitish band free from atoms. Discal dot absent.

Hab. Massachusetts, New Hampshire. Collections of H. K. Morrison and Boston Society of Natural History.

This species is very different from any described North American Cidaria. It can be recognized at once by the conspicuous white discal dot, and by the distinct lines of the anterior wings above, bordered with white.

EXPLANATION OF THE "CORRIGENDA" TO A COMMUNICATION IN THESE PROCEEDINGS, VOL. XV, PP. 381–384, ENTITLED: "ANISOPTERYX VERNATA DISTINGUISHED FROM A. POMETARIA." BY B. PICKMAN MANN.

In the preceding volume of these Proceedings, pp. 381–384, is a communication by me, in which our two common species of *Anisopteryx*, viz., *A. vernata* and *A. pometaria*, are described at length, and carefully discriminated. In this communication the names of the two species are used in a manner which, I have been convinced since, is exactly the reverse of correct. The object of the present communication is to explain and establish my later view.

At the time when that communication was made to the Society, and until the meeting of the Entomological Section on the 26th of November last, I had never entertained a doubt that Harris called the two species of *Anisopteryx* in question by the same names and with the same application which I had formerly used. Having had no occasion to examine the literature of the species, I accepted the current tradition, that the species described at length by Harris was the *vernata* of Peck.

Meanwhile, Mr. H. K. Morrison, in the course of his studies upon the Phalænidæ, had occasion to refer to the fifth volume of the "New England Farmer" (July, 1827), pp. 393–394, which contains a reprint of Peck's original article upon the canker-worm. After the species had been discriminated, as they were by me in the communication to which this is a supplement, it needed but the simplest reading of Peck's description to discover that I had wrongly applied the name of *vernata*. Mr. Morrison communicated this discovery to me on the 26th of November, 1873, and soon after, by reference to the plate in Peck's original article, I verified it. The question then arose, whether the species, hitherto miscalled *vernata*, had ever received a valid name.

Guided by the light of our present discovery, a critical examination of the text in Harris' Treatise enabled us to decide that the name of *pometaria* legitimately belongs to the fall species. Thus it results that I have to correct my former communication. At this late date I can do this properly only by the insertion of a slip into the completed volume of the Society's Proceedings.

In my former communication, I said that the necessity of applying the name *vernata* to a fall species illustrates the danger of attempt-ing to give names characteristic of season or locality. This illustration is now destroyed, but too numerous illustrations of the point could be given.

I give below a brief sketch of the principal articles upon the Canker-worms, as far as I have met with them. As I have already gathered much material for a complete discussion of the subject, I would be obliged for any assistance.

The original description of *Anisopteryx vernata* is to be found in an article in the Massachusetts Magazine, 8vo., for Sept. and Oct., 1795, Vol. 7, pp. 323–327, 415–416, entitled: "The Description and History of the Canker-Worm. By William Dandridge Peck," and accompanied by a plate, without explanation. The species is here described entirely in accordance with the description which I have given, heretofore, under the erroneous name of *A. pometaria*, and is designated as follows: "Phalæna (*vernata*[1]) geometra seticornis, alis cinereis, fasciis tribus obscuris, fuscis; posticis immaculatis: feminâ apterâ."

This article was reprinted in the "Rules and Regulations of the Massachusetts Society for Promoting Agriculture," 8vo., 1796, pp. 35–45, under the heading: "Natural History of the Canker-Worm. By Mr. William Dandridge Peck," and was accompanied by additional impressions from the original plate. Some verbal changes were made in the text.

The same article appeared again in the "New England Farmer," 4to. (6 July, 1827), Vol. v, pp. 393–394, with the omission of the last five paragraphs and the plate. This is not copied from the original article, but from the reprint cited above, and is entitled: "Natural History of the Canker-Worm. By William Dandridge Peck. (From Memoirs of the Massachusetts Agricultural Society.)"

From this time until the publication of Harris' "Report on the Insects of Massachusetts, injurious to vegetation," 8vo., 1841, no scientific mention of the species was made, as far as I have ascertained yet. Meanwhile, a great change seems to have come over the relations of the species to each other and to the world, for when Peck wrote, the occurrence of fall imagos was considered quite exceptional, while at the time that Harris wrote, the fall species was evidently far the more common.

I do not consider myself justified in building largely upon the foundation of my negative observation, that no specimens of *A. ver-*

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[1] From its appearing early in the spring.

nata have appeared in the fall; further observation is needed to confirm this as a rule. Successive authors have quoted so largely from one to another, without designating their own observations, and without giving the authority for their statements, that little reliance can now be placed on the statements of any.

Mr. LeBaron says, that the first mention of the Canker-worm, which he has met with, dates from 1789, when it is mentioned as occurring in Massachusetts, (2d Illin. Rep., 1872, p. 100). Peck says that the Canker-worm is said to have been observed first in the Southern States, where it is probably a native. (Mass. Mag., 1795, VII, p. 416). He states, that on the 17th of May, 1794, the night was so cold as to produce ice one-third of an inch thick; at that time a great part of the Canker-worms were hatched; to these the frost was so fatal, at Kittery, Maine, where he lived, that very few were seen in 1795. He paid diligent attention at the season of their rising, but found not one female, and saw but one male by accident, on the 6th of April. He says he earnestly wishes that this check, seconded by the endeavors of man, may extirpate this destructive insect. Was not his wish measurably gratified, as far as the *A. vernata* is concerned? I throw out this question as a suggestion for research. Assuming for the time, that whenever any fall imagos are mentioned the *A. pometaria* is referred to, we find that *A. pometaria* was comparatively rare when Peck was making his observations, while *A. vernata* was "one of the most obvious and destructive of the insects that inhabit the apple-tree." The Massachusetts Society for promoting Agriculture offered a large premium in 1793 for a satisfactory natural history of the Canker-worm, and another for a method of destroying the Canker-worm. The former premium was quickly secured by Mr. Peck, and a lesser one by Mr. Atwater, but the latter offer remained open and unsatisfied, from year to year, till 1813, when it was abandoned. The frost of 1794 (also mentioned by Mr. LeBaron) seems to have been very effective, for it is not till 1801 that we find in the "Papers on Agriculture," of the Mass. Soc. Prom. Agric., 8vo., 1801, p. 4, "The Canker-worm has in some places made its appearance again," and in the "Papers" of the same Society, 1807, p. 12, "Orchards have much improved of late [at Newbury] (since the year 1802), owing partly to the disappearance of the *canker-worm*," and in the "Massachusetts Agricultural Repository and Journal," 8vo., June, 1815, p. 316, "After having been freed for nearly twenty years from the ravages of the canker-worm [at Roxbury] our orchards are again overrun with them, and some of the most valuable trees of our country are threatened with destruction." Mr. J. Lowell, the author of the last quotation, says, *l. c.*, p. 317, "the insects rise in the fall."

Have we spanned the interval within which the relative importance of *A. vernata* sank, and that of *A. pometaria* arose? In the Journal last cited, Jan., 1816, Vol. IV, p. 89, Peck says, "It is certainly true that the canker moths rise in the autumn and deposit their eggs." But, he says, p. 90, "Those which rise in November are not very numerous, compared with those that rise in the spring." This certainly argues against my suggestion, if it is supposed to have been founded upon new observations, but not if it is merely a renewal of the statements made in 1795.

Harris, in his Report, in 1841, by an ingenious turn of expression, properly distinguished the males by description, without committing himself upon the question of their distinctness as species. The obscurity of his determining sentences, which I believe was intentional, as indicating the hesitation in his own mind, seems to have misled nearly all his successors. I have no doubt that he failed to be convinced of the distinctness of the species. His account of the habits is confounded with that given by Peck, in such a manner as to need revision. Among his manuscripts in the Library of this Society, I have found a figure of the male, female and egg of *A. pometaria*, which is labelled *Anisopteryx vernata*.

The text of Harris' work remains unchanged in regard to these species through the successive editions, as far as I am aware, but in the third edition (1862) the figures of *A. pometaria* have been inserted under the usual misapprehension.

The Harris Collection contains sixteen specimens of both species together, eleven males and five females. When the collection was arranged by the former Secretary of the Society, Mr. S. H. Scudder, printed Nos., with letters of the alphabet, were attached to each specimen, so that they can be referred to separately. In the following table I give in the first column these tickets; in the second column are Harris' Manuscript labels, corresponding as far as they go to his MS. Catalogue, from which I transcribe the proper portion; in the third column is the indication of the sex of the specimen; and in the fourth column the right name of the species.

Scudder's Numeros.	*Harris' Numeros, etc.*	*Sex.*	*Species.*	
552	334	♂	vernata	———
552 A	334	♂	———	pometaria
552 B	335	♂	———	pometaria
552 C	335	♂	———	pometaria
552 D	Canker-worm moth or with them, Nov. 20 '48.	♂	———	pometaria
552 E	Canker-worm moth, Nov. 30, '48.	♂	———	pometaria
552 F	335	♂	———	pometaria
552 G	360	♂	vernata	———
553		♂	———	pometaria
553 A		♂	———	pometaria
553 B		♂	vernata	———
553 C	129 ♀	♀	———	pometaria
553 D	335 ♀	♀	———	pometaria
553 E	335 ♀	♀	———	pometaria
553 F	334 ♀	♀	———	pometaria
553 G	334	♀	vernata	———

The corresponding portion of Harris' MS. Catalogue reads, as follows:

129	Phalæna	
334	*Geometra*	Apr. 1830. female apterous. Apr. 25. 1834. Apr. 10. 1835. perhaps one species.
335	"	1829 female apterous. Oct. 25. 1831. ♀ Apr. 25. 1831 and ⚥ Nov. 1832 Oct. 1835. ♂ ☿. Nov. 15. 1837 ♂ ♀ Nov. 1838 ♂ ♀.
360		

No. 129 comprises one ♀ *pometaria*; No. 334 comprises one ♂, one ♀ *vernata*, and one ♂, one ♀ *pometaria*; No. 335 comprises three ♂, two ♀ *pometaria*; No. 360 comprises one ♂ *vernata*. Besides these are two ♂ *pometaria* collected in Nov., 1848; and two ♂ *pometaria*, one ♂ *vernata*, without date.

Fitch, in his Third New York Report, contained in Vol. XVI, of the "Transactions of the N. Y. State Agricultural Society, for 1856," reverses the names of the species, (§ 38, pp. 342–343).

In Packard's "Guide to the Study of Insects" (1869), pp. 324–325, *A. pometaria* is called *A. vernata* Peck, and *A. vernata* is called *A. pometaria* Harris. The two species are correctly discriminated as forms, although their distinctness is doubted. But the true *A. vernata* ♂ is figured in connection with the description of the true *A. pometaria* ♂. Evidently the intention is the same in the figure of the female. The figure of the female is enlarged, a fact which is not stated in the text, though it is mentioned in the explanation of the plate, and no measurement of the female is given.

Riley's Second Missouri Report (1870), 8vo., pp. 94–103, contains an article on the Canker-worm, from which it appears that *A. vernata* is the more common species in the West. Mr. Riley states that some of the moths come out of the ground in November. Is this a quotation or an observation? If it is an observation, what is the species? The original matter in this article will become valuable when the descriptions are assigned to their proper species. The figures of the preliminary stages are copies of those in Harris' Treatise (1862), pp. 461–465, and therefore belong to *A. pometaria.* The figures of the male and female are copies of those in Packard's Guide (1869), tab. 8, f. 9, 9a, and, therefore, belong to *A. vernata.* The figure of the female is enlarged and no measurement is given.

LeBaron's Second Illinois Report (1872), 8vo., pp. 99–116, seems to treat only of the true *A. vernata*, but reproduces the figures given by Riley. The measurement of the female is given. Mr. LeBaron implies that some imagos appear in the fall. The difference of species sufficiently explains the difference of habits, in regard to which Mr. LeBaron criticizes the statements of Harris.

Dr. A. S. Packard, Jr. exhibited drawings of the supraœsophageal ganglion (brain) of the blind crayfish, *Cambarus pellucidus*, from Mammoth Cave, made from specimens kindly loaned by Professor J. Wyman, and also of the ordinary Cambarus (sp. undet.) of DesMoines River, Iowa, and showed the differences between them consisted mainly in an enlargement of the sides of the ganglion in the blind species; supposed to be connected with the sense of hearing. He also exhibited drawings of the inner structure of the eye of the blind species, showing that the pigment cells are white, and the whole eye in a state of arrested development.

January 7, 1874.

The President in the chair. Eighty-three persons present.

REMARKS OF PRESIDENT BOUVÉ.

Since we last met an event has occurred that has brought deep sorrow to our hearts, and indeed moved with grief those of the whole community; for whilst in the death of Louis Agassiz we have lost a distinguished Honorary Member, a pioneer in the paths we love to tread, one whose name deservedly ranks high among the most illustrious of those who have explored the world of matter and of life, the great body of the community has lost one whom it has long and justly regarded as pre-eminently the great teacher in science, the man of all men, who inspired the love of knowledge, and who was never weary in his efforts to impart the best he knew to every seeking soul.

Truly all alike, learned or unlearned, high in attainments and position, or only humble seekers of truth, may well weep the loss of him, whose presence alone was to everybody an inspiration.

To those of us who have been in any degree sharers in his labors, or companions in literary or scientific circles, his loss is irreparable.

The fine physical form, the countenance ever beaming with feeling and intelligence, the expressive utterances, and above all, that subtle influence which came from the whole being of the man, alas! that these are now only matters of memory.

But it is not for me to dwell upon the event I have alluded to. For a fit expression of the loss sustained by the

Society, we have the privilege of looking to one whose valuable services to it in its earlier days we have not forgotten, and who was one of the first among scientific men to welcome to our shores and our companionship the great naturalist. I need not say I refer to our former President, Mr. George B. Emerson, whom I now have the pleasure to introduce to you.

ADDRESS OF MR. EMERSON.

I thank you, Mr. President, for the great honor you do me by inviting me to say something before, and in behalf of, your Society, in commemoration of the most distinguished naturalist that has appeared among us. You know how reluctantly I consented to speak, and I feel how inadequately I shall be able to represent the Society. Yet I cannot but admit that there is some apparent propriety in your request. I was one of those who formed this Society. All the others who first met, except one, are gone; Dr. B. D. Greene, Dr. J. Ware, F. C. Gray and the rest. My old friend, Dr. Walter Channing, alone, in whose office most of the first meetings were held, is still living. Moreover, while I was in the seat you now occupy, it was agreed by my associates that it was very proper and desirable that a Survey of the State, Botanical and Zoological, should be made, to complete that begun by Prof. Hitchcock in Geology. At their request I presented to Gov. Everett a memorial suggesting this.

Our suggestion was graciously received. Gov. Everett brought the subject before the Legislature, in which some friends of Natural History in the House of Representatives had already been acting toward the same end; an appropriation was made, and he was authorized to appoint a commission for that purpose. On that commission four members of this Society were placed; the reports of three of whom, Dr. Harris, Dr. Gould and Dr. Storer, have been, and still continue to be, considered of signal and permanent value, and Mr. Agassiz himself regarded them as among the best reports ever made. It has given and still gives me the greatest satisfaction to know that the Society has been continually going forward, and that it is now more prosperous than ever.

A little more than twenty-seven years ago, as I was sitting in my study, a message came to me that two gentlemen desired to see me. They were immediately admitted, and Dr. Gould introduced me to Louis Agassiz. His noble presence, the genial expression of his face, his beaming eye and earnest, natural voice, at once gained me, and I responded cordially to his introduction. He said, "I have come to see you, because Dr. Gould tells me that you know the trees of Massachusetts; I wish to be made acquainted with the Carya. I have found the leaves and fruit of several species in the Jura Mountains, where they were deposited when those mountains were formed; but, since that time, none have been found living in Europe. I want to know them as they are now growing."

I told him that I knew all the species found in New England, and should be glad to show them to him. "But I have," I said, "presently to begin my morning's work. If you will let me call on you immediately after dinner, I shall be glad to take you to them."

At the time fixed, I called on him at his lodgings and took him, in my chaise, first to Parker's Hill, where one species of hickory grew, then through Brookline, Brighton and Cambridge, where two others were found, and to Chelsea, where a fourth, and one that might be a variety, were growing. I pointed out the characteristics of each species in growth, branching, bark, fruit and leaves, and especially in the buds. He listened with the most captivating attention, and expressed surprise at my dwelling upon the peculiarities of the buds. "I have never known the buds to be spoken of as characteristic," said he; "that is new to me." He admitted the distinct peculiarities of structure in the buds; and, I have no doubt, remembered every word I said, for, a few months afterwards, I saw, in a newspaper, that Mr. Agassiz would give a lecture, in Roxbury, on the buds of trees.

We drove on to Chelsea Beach, which stretches off several miles, — apparently without end, — and, as the tide was very low, was then at least a quarter of a mile wide. He was charmed with everything, expressing his pleasure with all the earnestness of a happy child, hardly able to restrain himself in his admiration and delight. He told me that he had never before been on a sea-beach, but that he was familiar with the undulations and wave marks on the old beaches laid open in the Jura Mountains.

I need not say what a pleasant drive this was. I had long felt great interest in various departments of Natural History, but had been so fully occupied with my own duties, as a teacher, that I had been able to indulge myself fully, and that for a small part of the year, in one only. Here was a companion who was intimately acquainted with all, and with the most distinguished men who had been advancing them, and who was ready and happy to communicate wealth of information upon every point I could ask about.

Some days after, I invited all the members of this Society to meet Mr. Agassiz at my house. Every one came that could come. They conversed very freely on several subjects, and Agassiz showed the fulness of his knowledge, and his remarkable powers of instant observation. All seemed to feel what a precious accession American science was to receive.

Not long afterwards, Mr. Agassiz accepted an invitation to spend Christmas with us. We took some pains, ourselves and our children, among whom were then two bright boys, full of fun and frolic, one in college, and one nearly prepared to enter. He was easily entertained, entering heartily, joyously and hilariously, into everything, games and all, as if he were still as young as the youngest, but full of feeling, and moved, even to tears, by some poor lines to him and his native land.

My friends, I have thus shown you how intimate I became, for a few weeks, with Agassiz, whom I found the wisest, the most thoroughly well-informed and communicative, the most warm-hearted and the most modest man of science, with whom, personally, or by his works, I had ever become acquainted. I did not keep up that intimate acquaintance, both because I was too busy in my own work, and because I did not deem myself worthy to occupy so much of his time, consecrated, as it was, to science and the good of mankind. The strong impression he made on me, was made on almost all who ever listened to, or even met, him. It is not surprising then, that

The news of the death of Agassiz caused a throb of anguish in millions of hearts. Such a death is a loss to mankind. What death among kings or princes in the Old World, or among the aspirants for power, or the possessors of wealth, in the New, could produce such deep-felt regret?

He is gone. We shall see his benignant face and hear his winning voice no more; but we have before us his example, and his works. Let us dwell, for a few moments, on some features in his life and character, as an inspiration and a guide, especially to those who mean to devote their leisure, or their life, to Natural History, or to the great work of teaching! What a change has taken place, in the whole civilized world, and especially in this country, in men's estimation of the value and interest of these pursuits, since he began his studies. To whom is that change more due than to Agassiz?

He was endowed by nature with extraordinary gifts. His fascinating eye, his genial smile, his kindliness and ready sympathy, his generous earnestness, his simplicity and absence of pretention, his transparent sincerity;—these account for his natural eloquence and persuasiveness of speech, his influence as a man, and his attraction and power as a teacher. For the development and perfecting of many of his highest and most estimable qualities of mind and character, Mr. Agassiz was doubtless indebted to his noble mother, who, judging from every thing we can learn, was a very rare and remarkable woman. To the quiet, homely, household duties, for which the Swiss women are distinguished, she added, unconsciously, very uncommon mental endowments, which she wisely cultivated by extensive reading of the best authors, and by conversation with the most intelligent persons.

Trained by such a mother, Agassiz grew up in the belief of a Creator, an infinite and all-wise Intelligence, Author and Governor of all things. He was sincerely and humbly religious. During his whole life, while exploring every secret of animal structure, he saw such wonderful consistency in every part, that he never for a moment doubted that all were parts of one vast plan, the work of one infinite, all-comprehending Thinker. He saw no place for accident, none for blind, unthinking, brute or vegetable selection. Though he was a man of the rarest intellect, he was never ashamed to look upwards and recognize an infinitely higher and more comprehensive Intellect above him.

In his earliest years and through childhood, he was surrounded by animals, — fishes, birds and other creatures, — which he delighted to study, and with whose habits and forms he thus became perfectly familiar. His education, in all respects, was very generous and thorough. He spent his early years in some of the most distinguished schools and colleges in Germany; and he had the good fortune to be made early a student of the two great languages of ancient times. He became familiar, by reading them in their native Greek, with the high thought and reasoned truth and graceful style of Plato, and the accurate observations and descriptions of Aristotle, the nicest observer of ancient times, and justly considered the father of natural history. Probably no work has been more suggestive to him than Aristotle's History of Animals; and probably his own breadth of conception and largeness of thought, upon the highest subjects, were due, in no inconsiderable degree, to his early familiarity with Plato. He also read some of the best Latin authors, and wrote the language with great ease.

No one who, early, has the time and opportunity, and who desires to become a thorough naturalist, or a thinker on any subject, should neglect the study of these two languages. From them we borrow nearly all the peculiar terms of natural science, and find the originals of almost all the words which we use in speaking on ethical, metaphysical, æsthetical and political subjects, and no one can be sure that he perfectly understands any of these words unless he knows them in their original language.

I dwell upon this subject, because I believe that the early study of language, especially of the ancient languages, is far too much undervalued. We use language, not only in our communication with others, but in our own thoughts. On all subjects of science, or whatever requires accurate thought, we think in words, and we cannot think, even within ourselves, upon any subject, without knowing the words to express our thoughts. He who is most fully and familiarly acquainted with the richest language and the thoughts that have been expressed by it, has the power of becoming not only a good thinker but an eloquent speaker. No greater mistake can be made, in the early education of the future naturalist, than the neglect to give him a full and familiar acquaintance with the words by which thought can be carried on or communicated.[1]

Agassiz's mother-tongue was French, but both this and German were in common use in the Pays de Vaud. He lived, for years afterwards, in several parts of Germany, and thus attained, without special study, the rich language which we Americans have to give so much time to acquire; and he lived, long, a studious and laborious life in Paris, where he became intimately acquainted with Cuvier and other distinguished naturalists, and perfectly familiar with the French language in its best form. More than once, when he was putting his note-book into his pocket, he told me he knew not whether he had made his notes in German or in French.

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[1] It is a matter of the greatest satisfaction that the only true mode of learning language, the natural one, by word of mouth from living teachers, is becoming common; the language itself first, and afterwards the philosophy of it—the rules. It is most desirable that this mode of learning the ancient languages should be introduced, to learn first the language, to read and understand it, and afterwards the rules. Indeed I would not recommend the study even of Greek, if most or much of the time given to it had to be thrown away upon the grammar. The true mode, Agassiz' mode, of teaching on all subjects, is becoming more and more common.

Agassiz's universality of study and thought suggest a precious lesson. It is never safe to give one's self entirely to one study or to one course of thought. The full powers of the mind cannot so be developed. Nature is infinite; and a small part of one kingdom cannot be understood, however carefully studied, without some knowledge of the rest.

Neither must a man allow himself to be a mere naturalist. Every man ought to seek to form for himself, for his own happiness and enjoyment, the highest character for intelligence, and for just and generous feeling, of which he is capable. He is not a mere student of a department of nature. He is a man; he must make himself a wise, generous and well-informed man, able to sympathise with all that is most beautiful in nature and art, and best in society. It would be a poor, dull world, if all men of talent were to educate themselves to be mere artisans, mere politicians, or mere naturalists.

Agassiz took a large, comprehensive view of the whole field of natural history; his thorough education and intimate acquaintance with the works of the highest men in several walks, Von Martius, Cuvier, Humboldt, and others, made it possible for him to do it, and he then fixed on certain departments, and, for the time, he gave himself entirely to one.

As a future inhabitant of America, it was fortunate for him to have been born, and to have grown up, in one of the free cantons of Switzerland. He was thus accustomed to treat men as equals; and thus his perfect familiarity and his freedom from all assumption were as natural to him as they were graceful and winning. He looked down upon none, but felt a sympathy with every thing best in every heart. The reality of these great human qualities gave a natural dignity which his hearty and ready laugh could never diminish. Every one was drawn toward him by what was best in himself. With the greatest gentleness he united a strong will, and with a resolute earnestness, untiring patience. His great object was truth, and, as he never had any doubt that it was truth, he may have been impatient, but he never felt really angry with those who opposed it.

Mr. Agassiz had, for several years, the great advantage and privilege of being an assistant, in the description and delineation of fishes from Brazil, to Von Martius, the genial and eloquent old man of Munich. In him he had the example of a man, who, with great resources as a naturalist, had, for many years, given himself, in a foreign country, to the study of a single department of Botany, without, however, shutting his eyes to any thing that was new and remarkable in any page of Natural History. To one who was a good listener and never forgot what he heard, what a preparation must this have been for his own expedition, many years after, to the sources of the Amazon, to which he was invited by the Emperor of Brazil, in which he was assisted by the princely aid of his own friends, and from which he brought home a greater number of new species of fresh water fishes than were ever before discovered by one individual, thus carrying forward that work upon the fishes of Brazil, his first work, which he had published when he was twenty-two years old.

He spent the leisure of several years in examining the reefs and dredging in the waters of the coast of Florida and other parts, always bringing home stores of new species and genera, and completing the history of innumerable known ones. What a preparation were these years for the great Hasler expedition, in which the depths of the ocean were very fully explored, and innumerable objects, new and old, were brought up, showing that the bottom of the ocean is any thing but barren, and throwing new light upon the geology of recent and of ancient times.

Whenever Mr. Agassiz undertook a special work, he prepared himself for it by a careful study of whatever had been done in that particular line by all others. He had seen, everywhere, indications of the action of ice. He determined to investigate. He began by reading all he could find upon the subject, and then set himself to observe, patiently and carefully, what was taking place in the glaciers themselves. He gave the leisure of several years to this examination, and then felt himself ready to observe the effects of similar action in former ages and distant regions. The opinions of such an observer, after such a preparation, cannot be without authority and value; and it is not surprising that he should not himself have been willing to yield them to those of others who had never given the same study to the subject.

When he wrote his wonderfully complete work upon the American Testudinata, he began by studying whatever had been written in regard to that group of animals, and he furnished himself, by the liberal aid of many friends, with immense numbers of specimens, so that he had ample means of satisfying himself in regard to almost every question that could be asked, as to structure or habits. Such a work will not need to be done over again for many years. It can never be entirely superseded except by a work showing greater diligence, greater fidelity and better powers of nice observation and faithful description.

Let no one who has not carefully examined this, and his other papers in the "Contributions to the Natural History of the United States,"[1] venture to speak of his incompleteness.

His example as a teacher has been of inestimable value, as showing the importance of the best and largest possible preparation, teaching by things really existing and not by books, opening the eye to the richness and beauty of nature, showing that there is no spot, from the barren sea-beach to the top of the mountain, which does not present objects attractive to the youngest beginner, and worthy of, and rewarding, the careful consideration of the highest intellect.

The town of Neufchatel, near which Mr. Agassiz was born, and particularly the hills behind it, give fine views of natural scenery. From a hill, not two miles from his former home, I had a view of the lake and the plains and mountains beyond, which I now recall as one of the widest, most varied and most exquisite, I have ever seen. Agassiz thus grew up to a love of the beautiful.

This love of the beautiful in nature has been increasing from the most ancient times to the present. It is more generally felt and more fully enjoyed now than ever before, and in this country, apparently, more than in any other. More persons leave the cities, as soon as they begin to grow warm and dusty, to enjoy the country or the seaside, the mountains or the lakes; and they enjoy rationally and heartily. Who has done more than Agassiz to increase this enjoyment? With thousands, it is becoming not merely the enjoyment but the study of the beautiful. Collections of shells, curious animals, minerals, sea-weeds, and flowers, are becoming, like libraries, not only sources of pleasure to the eye, but of delightful study, whereby a nearer approach is made to the very fountain of enjoyment; we not only see and feel, we begin to understand. The more we see of the uses, of the wonders, of the structure, the more profound is our enjoyment? Who has done more than Agassiz to awaken this enjoyment?

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[1] In speaking of the thorough execution of the work in these four volumes, we ought not to forget the aid he received from the exquisite skill in drawing and engraving of Sonrel, who wore out his eyes in the work, and of Burckhardt and Clark.

In 1855, with the aid of Mrs. Agassiz, who, from the beginning, did a great deal of the work, Mr. Agassiz opened a school for young ladies. For this he was, in all respects, admirably well qualified. The charm of his manner, his perfect simplicity, sincerity and warm-heartedness, attracted every pupil, and won her respect, love and admiration. He knew, almost instinctively, what we teachers have to learn by degrees, that we cannot really attract, control and lead a child, and help to form his habits and character, without first loving him; that nothing in the world is so powerful as real, disinterested affection. He gave, himself, by lectures most carefully prepared, an hour's instruction, real instruction, every day. All his pupils retain their respect and love for him, and some keep the notes they made of his talks, and read them with delight. The school was continued for seven years, with great success, attracting pupils from distant parts of the country.

One of the secrets of his success as a teacher was, that he brought in nature to teach for him. The young ladies of a large school were amused at his simplicity in putting a grasshopper into the hand of each, as he came into the hall; but they were filled with surprise and delight, as he explained the structure of the insect before them, and a sigh of disappointment escaped from most of them when the lesson, of more than an hour, closed. He had opened their eyes to see the beauty of the wonderful make of one of the least of God's creatures. What a lesson was this to young women preparing to be teachers in the public schools of the Commonwealth, showing that in every field might be found objects to excite, and, well explained, to answer, the questions, what? and how? and why? which children will always be asking.

He had all the elements necessary to an eloquent teacher: voice, look and manner, that instantly attracted attention; an inexhaustible flow of language, always expressive of rich thoughts, strong common sense, a thorough knowledge of all the subjects on which he desired to speak, a sympathy with others so strong that it became magnetic, and a feeling of the value of what he had to say, which became and created enthusiasm. He thus held the attention of his audience, not only instructing and persuading them, but converting them into interested and admiring fellow students.

His mode of teaching, especially in his ready use of the chalk and the blackboard, was a precious lesson to teachers. He appealed at once to the eye and to the ear, thus naturally forming the habit of attention, which it is so difficult to form by the study of books. Whoever learns this lesson will soon find that it is the teacher's part to do the study, to get complete possession of what is to be taught, in any subject, and how it is to be presented, while it is the part of the pupils to listen attentively and to remember. This they will easily do, and, to show that they do remember, they may be easily led to give an account, in writing, of what they have heard. Every lesson will thus be not only an exercise of attention and memory, but a lesson in the English language, proper instruction in which is very much needed and very much neglected. Whenever a pupil does not fully understand, the teacher will have the opportunity, while he is at the blackboard, of enlarging and making more intelligible.

Wherever the teacher shall be successful in adopting this true and natural mode of teaching, the poor text-books which now infest the country will be discontinued, and those who now keep school will become real teachers; school keeping will be turned into teaching. When this method is fairly introduced, we shall hear no more of long, hard lessons at home, nor of pupils from good schools who have not learned to write English.

The advent of Agassiz is to be considered a most important event in the Natural History of the country. The example of his character, his disinterestedness, his consecration to science, his readiness to oblige even the humblest and most modest, his superiority to self-interest, his sincerity and absence of all pretention, his enthusiasm in all that is noble — all these recommended not only him, but the science he professed. Never was a life more richly filled with study, work, thought; and all was consecrated, not to the benefit of himself, but to the promotion of science for the good of his fellow creatures.

For many years Mr. Agassiz has seemed to live only for the advancement of natural history, by the building up of his Museum, for which he had collected materials, of the greatest possible diversity, which would, properly cared for and arranged, form a Museum superior in numbers and variety to any similar collection in the world. Shall this great work be allowed to fail?

Let every person who honors the memory of Agassiz, say No! Let every one who regrets that the great main support of the noble structure is taken away, resolve that it shall not fail, BUT that, so far as depends on him and what he can do, IT SHALL GO ON AND BE BUILT AND FILLED, AND STAND FIRM, A GLORIOUS TEMPLE OF SCIENCE FOREVER.

REMARKS OF REV. MR. WATERSTON.

In response to an invitation from the chair, the Rev. Mr. R. C. Waterston spoke of Prof. Agassiz's connection with the Centennial Anniversary of the birth of Humboldt.

At a meeting of the Boston Society of Natural History, June, 1869, it was moved and voted that a celebration of the Centennial Anniversary of the birth of Alexander von Humboldt, by this Society, is highly desirable. It was also suggested that Professor Agassiz be invited to deliver an address upon the occasion. The invitation was extended to Professor Agassiz and accepted.[1] Various circumstances connected with that memorable occasion, at a time like the present, come to the mind with peculiar power.

In Professor Agassiz's public address, his introductory remarks were, "I am invited to an unwonted task. Thus far I have appeared before the public only as a teacher of Natural History. To-day, for the first time in my life, I leave a field in which I am at home, to take upon myself the duties of a biographer."

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[1] The Committee appointed at the meeting in June, to make all desirable arrangements, were, R. C. Waterston, Jeffries Wyman, N. B. Shurtleff, Samuel Kneeland and Samuel H. Scudder. To this Committee was afterwards added T. W. Higginson.

Thus this Society had the privilege of inviting Professor Agassiz to a duty (most nobly fulfilled), which without this invitation in all probability he would never have entered upon. That being, as he himself expressed it, the first time in his life he had undertaken such a task; it was also, as we now know, destined to be the last. This event which, on every account, had great interest, for these reasons possesses a solemn and sacred import. That anniversary we would keep in grateful remembrance, forming as it does, in connection with many reminiscences, an added and, may we not say, an indissoluble tie between us and him.

At the time when the invitation was extended to Prof. Agassiz, he was overwhelmed with work; while, by previous labor, both body and mind had already been overtaxed. Under such circumstances, it would have appeared next to impossible for him to comply with the request of the Society, yet so desirous was he to meet their wishes that he undertook the task.

On the 8th of June Mrs. Agassiz wrote: —

"Though your letter touched and gratified me deeply, it made me very anxious, too. I could almost have wished the occasion had not arisen, for it alarms me to see the way in which work accumulates upon Mr. Agassiz, whose health is no longer so good as it used to be.

"It seems as if it would be easy for him to talk of Humboldt, and so, out of the fulness of his heart, it would; but on such an occasion, the address must include a very careful review of all the facts of his life, of his relation to science through three-quarters of a century; it must be accurate as well as comprehensive, and even Humboldt's most intimate friend could not prepare it without a good deal of care and research. I do not say this because I would dissuade Mr. Agassiz from it; on the contrary, it seems to me a duty, which, since it arises, he cannot avoid; and I think he fully intends to undertake it, though not without many fears lest he should not rise to the grandeur of the occasion.

"Mr. Agassiz begs me to say that he has the greatest desire to further the project to the utmost of his power, and only fears, as I have said, to fall short of his own wishes, and the expectations of those who are willing to entrust him with such a responsibility."

On the 3d of July Prof. Agassiz wrote as follows: —

"For weeks past I have intended every day to write you, but the fact is that just now I have scarcely time to breathe, and with the sincere desire of accepting the invitation tendered to me through you, I have been trying to free myself in some degree of the tasks before me. It is not so easy to do this as it seems.

"However, I write now to say that I will do my best so far as it depends upon me, to make the Anniversary of Humboldt worthy of his memory, and servicable to science in the country. The task will be a difficult, and in some respects a painful, one to me, none the less because of my personal relations with him. But I will do my best, and I beg you to believe that the confidence placed in me by those who wish to make this occasion a marked day, has gratified and touched me deeply.

"I wish you would express this sentiment in my behalf, and add that my great cause of hesitation has been the fear that I might not satisfy the expectations of those who have thus honored me. Believe me,

"Ever truly yours,

"LOUIS AGASSIZ."

In a note dated July 21st, he says,

"I have been completely prostrated this week."

Yet notwithstanding this exhaustion (doubtless far beyond what was imagined by his most intimate friends, and, added to this, serious illness among the members of his own family, his son leaving for Europe, on account of his health, the very day upon which the address was delivered), Professor Agassiz most conscientiously devoted himself through the sultriness of an intensely hot mid-summer, to the work of preparation. Few are probably aware what a mind like his would, under such circumstances, consider requisite. Nothing was to be taken for granted; not even the memory of former investigations would be accepted without passing through the process of examination. Every step was to be measured, with critical exactness, through the long progress of Humboldt's scientific career.

Is there not exemplified in this fact, one of the marked characteristics of Prof. Agassiz's mind? Absolute thoroughness; sifting every question and principle down to its first elements; tracing every thought, from its earliest germ through each successive development, until the final result is reached.

In order to secure freedom from all interruption during these researches, he asked for a room at the City Library, which was readily granted. Here he could gather about him papers and books, which during his absence would remain undisturbed. Mr. Winsor, the efficient and obliging Superintendent, tells me that for more than a month Prof. Agassiz passed at least three or four days of each week, from nine o'clock in the morning until generally three o'clock in the afternoon, and that during this time he called for more than two hundred volumes in different languages, always desiring to read each work as it originally came from the mind of the author. Thus every work which Alexander von Humboldt ever wrote passed under careful review; not only every volume, but every pamphlet, with the exception of one, which could not be found in this country.

On the 4th of September he wrote me,

"I have only yesterday finished gathering my materials, and have not yet begun preparing my address."

He adds—"My friends will never know what anxieties I have to go through on this occasion."

Six days after this I received the following:—

"*Nahant, Sept.* 10*th*, 1869.

"MY DEAR SIR:

"I have succeeded this evening in bringing to a close my draft of an address; not exactly as I would like to deliver it but such as I may be compelled to read should the occurrences of the day unfit me for an extemporized discourse, which I believe might be more effective."

It would thus appear that even after the address was written, he hoped to give, not what he had embodied in manuscript, but the result of which that would be the basis, in the form of an extemporized discourse, for which, as all know from his constant habit of speaking without notes, he possessed the very highest qualifications.

However, to meet every contingency, he adds:—

"As I go to-morrow to Cambridge, I will try to have my illegible manuscript set in type, that I may myself be able to read it. At the same time I shall see how my diagrams are progressing, and if satisfactory, forward them at once to the Music Hall. Very truly yours,

"L. AGASSIZ."

On the 13th of September he wrote:—

"DEAR SIR:—

"I hope I may have a proof of my address for your reporters by the time I reach Boston to-morrow, which I shall hand to you. My diagrams went to the Music Hall Saturday afternoon, with the palm-branch worn on Humboldt's funeral.

"The pen taken from his desk the day he died, and sent to me, I shall bring myself, fearing it might be lost if left with bulkier objects. Very truly yours,

"L. AGASSIZ."

Such were some of the preparatory labors connected with the address which was to be heard on that Centennial Anniversary by literary and scientific men in every part of the country. Seldom has there been an occasion in the history of New England, which has brought together so brilliant an assemblage of able scholars and prominent men in every department of thought.

At the evening reception, Mr. Ralph Waldo Emerson, in speaking of what he termed the "delightful address in praise of Humboldt," concentrated his estimate in this characteristic declaration, "our eminent professor never delivered a discourse more wise, more happy, or of more varied power."

These words expressed the universal feeling. And the address, so cordially welcomed by those who heard it, was received when published with equal favor on both sides of the Atlantic.

This very day, I was reading a letter by Sir John Herschel expressing his commendation; and in the Life of Alexander von Humboldt, edited by Professor Karl Bruhns, director of the observatory at Leipzig, the address by Agassiz is referred to, both in the preface, and in the body of the book. In the latter, a lengthy extract is introduced. [See Vol. II, pp. 179, 180 and 181.]

There were several occasions upon which Alexander von Humboldt extended such attention and kindness to Agassiz, at a time when encouragement was most needed, that it seems but an act of justice and gratitude to recall them here. The first was related by Agassiz some fifteen years ago, at a meeting of the American Academy of Art and Science, soon after Humboldt's death.

"May I be permitted," he said "to tell a circumstance personal to me? I was only twenty-four years of age when in Paris, whither I had gone with means given me by a friend, but I was at last about to resign my studies from want of ability to meet my expenses. Professor Mitscherlich was then on a visit in Paris, and I had seen him in the morning, when he had asked me what was the cause of my depressed feelings, and I told him I had to go, for I had nothing left. The next morning as I was seated at breakfast, in front of the yard of the Hotel, where I lived, I saw the servant of Humboldt approach, he handed me a note, saying there was no answer and disappeared. I opened the note, and I see it now as distinctly as if I held the paper in my hand. It said:

'My Friend: —

'I hear that you intend leaving Paris in consequence of some embarrassments. This shall not be. I wish you to remain here as long as the object for which you came is not accomplished. I enclose you a check of £50. It is a loan which you may repay when you can.'"

That one act of Humboldt, at the turning point in the life of Agassiz, may have affected the whole course of his after career. If Sir Humphrey Davy could say "My best discovery was Michael Faraday,"— what shall we say of this discriminating instance of generous encouragement, which perhaps gave to us Agassiz as a man of science!

In the address upon Humboldt, Agassiz speaks of his studies at Munich, whose University had opened under the most brilliant auspices, and where nearly every professor was prominent in some department of science or literature. "These men," he says, "were not only our teachers but our friends. We were the companions of their walks and often present at their discussions." "My room," he adds, "was our meeting-place, bed-room, study, museum, library, lecture-room, fencing-room, all in one. Students and professors used to call it the little Academy."

It was at this time that Humboldt was preparing for his Asiatic journey. Agassiz was anxious to accompany him, and asked that he might join the expedition as an assistant. This was the beginning of his personal acquaintanceship with Humboldt.

A graphic picture is presented of the student's life in Paris, in the days of Louis Philippe, when Cuvier, just the age of Humboldt himself, was active and ardent in research, his salon frequented by statesmen, scholars and artists.

Cuvier was then giving a course of lectures, in the College of France, on the History of Science. "Humboldt," says Agassiz, "attended these lectures regularly; I had frequently the pleasure of sitting by his side, and being the recipient of his passing criticism." At this period, Humboldt had his working-room at the Rue de la Harpe. "There," continues Agassiz, "it was my privilege to visit him frequently. There he gave me leave to come, to talk with him about my work, and consult him in my difficulties."

At this time Agassiz was twenty-four years of age, and Humboldt sixty-two.

"I had recently," says Agassiz, "taken my degree as Docter of Medicine, and was struggling, not only for a scientific position, but for the means of existence also. I have said that he gave me permission to come as often as I pleased to his room, opening to me freely the inestimable advantages which intercourse with such a man gave to a young investigator like myself. But he did far more than this, occupied and surrounded as he was, he sought me out in my lodging."

Here he gives a most interesting account of a visit from Humboldt, at Agassiz's narrow quarters, in the Hôtel du Jardin des Plantes. After which is an invitation from Humboldt, to meet him at the Palais Royal — where they dine,— "a rare indulgence," says Agassiz, "for a young man, who could allow himself few luxuries." "Here," he adds, "for three hours, which passed like a dream, I had him all to myself. How he examined me, and how much I learned in that short time! How to work, what to do, and what to avoid; how to live, how to distribute my time; what methods of study to pursue; these were the things of which he talked to me, on that delightful evening."

When we reflect upon the extended reputation acquired by Agassiz before he left Europe; of that visit to this country which led him gladly to adopt it as his home, and of the untiring zeal with which he devoted to it the best years of his life; shall we not hold in grateful remembrance the man who gave to him, at the most critical moment, the cordial hand of friendship, and who by his cheering words, inspired fresh ardor, and a hope which no after trial could extinguish?

It is more than a pleasant picture, it is a lesson for all time, and should awaken, through generations, the desire generously to encourage and wisely to aid.

THE HUMBOLDT SCHOLARSHIP.

It was in this spirit that a "Humboldt Scholarship" became associated with the Humboldt Anniversary. Through personal solicitation on the part of the committee the sum of Seven Thousand dollars was subscribed to form a permanent fund, the income of which, under the direction of the Faculty, was to be solely applied to the aid of young and needy students, while pursuing their preparatory studies at the Museum of Comparative Zoölogy, in Cambridge. The founding of this scholarship[1] was the voluntary proposition of this Society as a token of sympathy and hearty good-will.

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[1] The amount of the Fund of the Humboldt Scholarship, reported by the Treasurer (Mr. Theodore Lyman), in January of the present year, was $8,504.43.

The following note will illustrate the manner in which this scholarship is made practically useful to the individual, while at the same time it aids in the advancement of science.

"At a meeting of the Faculty of the Museum of Comparative Zoölogy, held May 6th, 1871:

"The Humboldt Scholarship was awarded to J. A. Allen—in consideration of his paper upon the Mammals and Winter Birds of East Florida, and the proceeds of the Humboldt Fund—for one year, and granted to him in aid of his Exploration of the Fauna of the Rocky Mountains."

In a recent communication Mr. Lyman says: —

"The fund is just what we need, and its value must always be of the first order."

The gratification of Professor Agassiz was at once expressed. In a note written July 3d, he says:

"Your proposition to connect a scholarship with the Museum of Comparative Zoölogy, in commemoration of this occasion, has had great weight with me. I believe that such an arrangement will not only be an ever-returning memento of the solemnities of this 14th of September, but, if properly conducted, will contribute to the real advancement of Natural History among us."

The origin of this scholarship was by some misapprehended. It was supposed to have been suggested, directly or indirectly, by Professor Agassiz. This is an entire mistake. No one could feel more sensitive than he himself did upon this subject. His feelings are frankly expressed in a note which I received from him, after he had read a paragraph in the daily papers, referring this movement to him.

"My Dear Sir:—

"In a paper to-day, giving an account of the proposed celebration, 'a plan' is alluded to 'of Mr. Agassiz for founding a Humboldt Scholarship in the institution of which he is the head.'

"This is no doubt a simple error of the press, but I should be very sorry to have it stand. It would have been very ungracious in me, and would have shown, to say the least, a great want of delicacy, had I suggested an endowment for the Museum in which I am personally interested. It was, as you know, a proposition made spontaneously without any reference to me. And though I rejoice in it and feel doubly unwilling, on account of this offer, to shrink from the responsibility connected with the invitation of your committee, yet the suggestion coming from me, under the circumstances, instead of being appropriate, would be wholly unbecoming.

You will excuse me for troubling you about this, but I am sure you will see that it places me in an awkward position."

If in any mind there should exist even the shadow of a misapprehension upon this subject, these words will serve to explain fully both the feelings of Prof. Agassiz and the exact facts of the case.

At the close of his public address of the 14th of September, he says: —

"I have appeared before you as the representative of the Boston Natural History Society. It was their proposition to celebrate this memorable anniversary. I feel grateful for their invitation, for the honor they have done me. I feel still more grateful for the generous impulse which has prompted them to connect a Humboldt Scholarship, as a memorial of this occasion, with the Museum of Comparative Zoölogy at Cambridge."

Thus, Mr. President and gentlemen, while we cannot but deeply mourn the vast loss which this community and the whole country has sustained by this bereavement, we rejoice in that friendly relationship which so long existed between us, and are thankful that one of the last great public utterances of his life was given under the auspices of this Society.

And now that his life, so beneficently crowded with activity and usefulness, has closed to us in this sphere of being, we are grateful that our mutual efforts established what will not only be a perpetual bond of union between this Society and the institution of which he was the honored head, but which, we trust, through successive years, may prove a source of practical help and encouragement to numberless students, who, by their future efforts, may extend the boundaries of knowledge, thus aiding in the work of human progress, while they carry forward to yet further completion, those investigations and discoveries which, in our own day, have given immortality to the names of Humboldt and of Agassiz.

Dr. T. Sterry Hunt made some remarks on the stratification of rock-masses.

The crystalline rocks are commonly divided into stratified and unstratified; the first being those whose arrangement suggests that they have been formed, like the uncrystalline sedimentary rocks, by the accumulation of matters at the bottom of seas or lake-basins; and the second those which are supposed to have been erupted or forced out in a more or less liquid state from the inner portions of the earth. These two classes correspond to what the author has designated indigenous and exotic rocks, but a third class must be distinguished, which he has called endogenous rocks, and which appear to have been deposited from solutions, not in open basins, but in fissures at greater or less depths from the surface, and under peculiar conditions of temperature and pressure. To these crystalline deposits belong the various veinstones, including many of the so-called granites, especially those containing the rarer mineral species.

The speaker desired to call attention to the fact that a stratiform or layer-like arrangement of the constituent parts is often met with, both in exotic and endogenous rocks, and cannot be regarded as characteristic of indigenous rocks, nor as a proof of aqueous deposition at the earth's surface. The banded structure in mineral veins parallel to their walls is well known, and was remarkably shown in some granitic veinstones exhibited from Ireland, from Maine and from Nova Scotia. In the latter case, the banded granite, looking like a coarse-grained gneiss, is seen to cut at right angles the strata of a mica-schist. This structure is clearly due to successive deposits from water of crystalline matter on the walls of the veins, and results from a process which, though operating in later times, and in subterranean fissures, was perhaps not very much unlike that which gave rise to the indigenous granitic gneisses.

Of a different origin is the stratiform structure often seen in rocks clearly exotic or erupted, which is apparently due to the arrangement of the elements in a flowing and imperfectly liquid material. This was well shown in a specimen from Groton, Connecticut, in which a large angular fragment of strongly banded micaceous gneiss is inclosed in a fine-grained eruptive granite, the mica plates in which are so arranged as to show a beautiful and even stratification in contact with the broken edges of the gneiss, but at right angles to the strata of the latter. A coarse-grained dolerite, from Montreal, Canada, was also shown, in which black augite crystals in bands of half an inch in width alternate with others of nearly unmixed white labradorite. These bands, which may be traced for a distance of several feet on glaciated surfaces, are found curiously contorted and interrupted, and in their drawn-out and lenticular arrangement suggest the extension by flow of a heterogeneous pasty mass, and the partial blending of an augitic portion with another more feldspathic. Similar appearances are equally conspicuous in the dolerite of Montarville, a few miles distant from the last. These dolerites were erupted probably before the Devonian period. A fine-grained, dark micaceous dolerite from a narrow dike cutting the Trenton limestone near Montreal was also exhibited, in which the abundant laminæ of mica (probably biotite) are arranged parallel to the walls of the dike. An eruptive diorite, shown from among the mesozoic sandstones at Lambertville, New Jersey, is conspicuously marked by light and dark bands, due to the alternate predominance of one or the other of the constituent minerals.[1] The speaker alluded to these cases of stratification in eruptive rocks only as fresh illustrations of a well-known phenomenon which has been repeatedly observed and described by geologists. A similar stratified structure is also seen in glacier-ice and in many furnace-slags. The consideration of such facts has led some geologists to suppose that the banded structure of the great areas of gneiss and gneissoid rocks was caused by movements of flow in a solidifying mass, and not to successive deposits of dissolved or suspended material from a watery medium. While admitting the frequent occurrence of this structure in eruptive rocks, and the necessity in many cases of a careful geognostical study to determine to which class a stratiform rock should be referred, the speaker maintained the truly indigenous character of the great formations of gneissic rocks, such as, for example, the Laurentian, which, from their wide extent, and from the mode of their association with layers of quartzite, limestone and iron-oxides, were clearly deposited in horizontal layers at the earth's surface.

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[1] From the study of the diorites interstratified with the mesozoic sandstones of New Jersey, Prof. Henry Wurtz has been led to look upon them as indigenous rocks, like the diorites of the Huronian series of crystalline schists, which they in many respects resemble. Notwithstanding his great respect for the opinions of this learned naturalist, Dr. Hunt, in common with most other geologists, regarded these mesozoic diorites as intrusive.

The following paper was presented by the Secretary: —

DESCRIPTIONS AND NOTES ON THE NOCTUIDÆ. BY AUG. R. GROTE.

Acronycta dactylina Grote.

♀. Smaller than *A. hastulifera* (*Americana* Harris); the primaries of a distinctly bluish grey. The median lines continuous and dentate. Orbicular small, a black annulet with empty centre. Reniform vague, with a blackish stain on the cross vein. Transverse posterior line double, with broad, pale enclosed space, the inner line faint, the outer black, distinct with acutely pointed outward dentations, more noticeable twice opposite the cell, and once broadly on subterminal fold, opposite which the inner line is accentuated. A (sometimes obsolete) narrow dash on the fold beyond the line. The t. p. line is followed by a diffuse, dark shade. Fringes grey. Terminal line marked by interspaceal black dots. Hind wings pale whitish grey, with a pale fuscous terminal shade. Veins a little darker marked; terminal dots indistinct; fringes whitish grey. Beneath whitish grey, with faint outer line on primaries, becoming denticulate and more distinct on the hind wings; blackish discal dots on both wings.

Expanse, 50 mm.

Hab. Quebec (F. X. Bélanger); N. Y. (E. L. Graef).

At first sight recalls *lepusculina*, but the species is larger, the primaries darker and the lines continuous, as in *hastulifera*.

Acronycta albarufa Grote.

♂ ♀ Allied to *A. ovata* but smaller. Primaries pale purplish grey. Transverse anterior line widely geminate, receiving a distinct black dash from the base which attains the outer of the two lines. Orbicular white, annulate, contrasting, with a dark central point, approximate to the reniform and divided from it by the black median shade, the latter continuous, less black inferiorly. Reniform complete, distinct, with a very evident reddish tinge suffusing the internal black crescent mark. T. p. line narrow, geminate with included whitish space, not prominently denticulate, indented opposite the cell and crossed by a narrow black streak above the angle. A dusky shade fills the subterminal space. The subterminal line is whitish, more or less evident, followed by blackish shades accentuated opposite the cell. Hind wings translucent fuscous in ♂, with faint line before the darker margin; darker in ♀. Thorax like fore wings; abdomen fuscous stained with vinous at tip in ♂.

Expanse, ♂ 30, ♀ 35 mm.

Hab. Missouri (C. V. Riley, "389, L., imago in May").

This species is conspicuous by its purple grey smooth colors and the contrasted white and red of its orbicular and reniform spots.

Acronycta lithospila Grote.

♀. In the shape of the wings and streaky shadings of the primaries this species is allied to *A. Xylinoides* Guenée. The ornamentation is almost entirely obliterate, the transverse lines marked by even oblique darker shades on costa. The color is dark steel gray with dull, inconspicuous, brownish shading on the cell, behind and accompanying the transverse posterior line and about the long, black, basal streak. The t. p. line is dentate, more evident than the other lines; it is even on the costal region and is seen to run further back than in *A. Xylinoides.* Whitish streaky shadings may be noticed on the cell accompanying a black discal streak, above internal angle below a very fine black streak, and again on submedian interspace before the t. p. line and on a line with the black basal streak. The reniform is incompletely indicated. Terminally the fore wings are paler grey with the veins marked with dark grey and with dark interspaceal shade streaks on the margin, accentuating the terminal dots so that the terminal space has a succession of blackish stripes on a paler grey ground. Hind wings whitish, with smoky nervules and faint, undefined terminal shade band. Beneath whitish, dusted with smoky scales, and with improminent discal mark and line on the hind wings. Thorax and head concolorous with fore wings. Palpi whitish, with the second joint black at the sides.

Expanse 35 mm.

New York.

In the markings this species resembles closely a gray Leucania, or Xylina.

Mamestra cinnabarina Grote.

♂, ♀. A small species with hairy eyes and a casual resemblance to *Euplexia lucipara* in the arrangement of the colors. Deep brown; the transverse lines picked out by pale, somewhat ochreous shades. Claviform black; orbicular indistinct, partly black, edged with pale central fleck; reniform pure white, contrasting, erect, with straight base, above which it is narrowed, with dark linear centre more or less obvious. Subterminal space contrastingly colored, light ochreous brown, reddish brown above on costa; subterminal line preceded by a reddish brown shade, the line itself is pale, followed by the blackish terminal space and fringes. The basal fields of the wing are more or less flecked with ochreous brown so that they appear paler than the median and terminal spaces. Hind wings fuscous without marks; beneath paler, without lines.

Expanse, ♂ 26, ♀ 24 mm.

Hab. California (No. 2750, Dr. A. S. Packard, Jr.).

Mamestra legitima.

Apamea legitima Grote, Proc. Ent. Soc., Phil., Vol. III, p. 82, Plate 2, fig. 4. (1864.)

I have received from Dr. Packard specimens of this species from Massachusetts, which have enabled me to correct my former generic reference. The eyes are hairy; in general tint the species resembles the much larger *Mamestra purpurissata* Grote.

Mamestra laudabilis.

Hecatera laudabilis Guenée. Noct. p. 30.

I have received specimens of this species from California, from Dr. Packard, so that we have a new locality for the species, the Californian specimens not differing appreciably from our Eastern material.

Hadena arctica Boisduval.

Vancouver Island (Dr. Packard).

Ufeus plicatus Grote.

California (No. 4414, Dr. Packard). The specimens do not differ from our Eastern material, while they are perhaps a little higher colored. There is a variability about the appearance of the discal longitudinal streak, while in one specimen the transverse line is obsolete. Both sexes of the two species of Ufeus have now been observed.

Heliothis (Melicleptria) pulchripennis Grote.

♂. Eyes constricted. Fore tibiæ with a disproportionately long claw on the outside, and a short one on the inside, at the extremity; middle and hind tibiæ spinose. Fore wings intensely reddish purple with an arcuate inner median, and a slightly sinuate outer median bluish transverse line; the outer line accompanied by a broad, inner greenish shade; a greenish discal shade approximate to the inner median line. Hind wings blackish with a pale, central blotch and with pale fringes becoming purplish towards the apices. Beneath, the wings are pale, with rosy purplish shades along the costæ and external margins; the fore wings show a central black spot and the bases and internal margin of the hind wings are soiled with blackish. Head, thorax, and tibiæ with mixed purple and blackish, or purple and pale hair; abdomen blackish; the whole body is lengthily hirsute.

Expanse, 20 mm.

Hab. California (No. 4380).

In the style of ornamentation this brilliant species differs from *californicus*, *suetus* and *diminutivus* by the continuous, bluish median lines and the absence of the inferior blotches on the median space; in the course of the median lines the species resembles the yellow species, *Spraguei*, *arciferus*, etc.

Schinia rectifascia Grote.

More broadly winged and slighter bodied than *S. trifascia* Hübner, of a similar pale, dull, olivaceous color. The primaries have each three pale fasciæ, but these are much narrower and nearly upright in the new species. The two first, corresponding to the ordinary median lines, are nearly straight, wider apart than in *tri-fascia*, where they are approximate and very oblique. The third fascia corresponds to the usual subterminal line; it is outwardly projected beyond its costal inception, where it copies the course of the second fascia or outer median line. A pale linear discoloration at the extremity of the cell, in the place of the reniform. The fringes and terminal margin are stained of a brownish ochreous on both wings; the secondaries are silky discolored whitish. Beneath pale fuscous, with ochreous terminal stains, dyeing the fringes; and with costal traces of double darker common lines.

Expanse, 28 mm.

Hab. Pennsylvania, Alabama.

Catocala residua Grote.

♀. Dusky blackish. Fore wings obscure dusky blackish, like *C. obscura* in tint, but less evenly tinted and with a greater proportion of pale scales. Differing by the distinct black ordinary lines, the transverse posteriors more notably projected opposite the disc, where are two prominent, subequal, broadly marked teeth; subreniform open. The subterminal grey dentate shade is paler than in its ally, more obvious and deeply dentate and bent opposite the teeth of the t. p. line; the succeeding dusky shade in *C. obscura* is here obsolete. There is a distinct, diffuse, subapical, oblique, blackish shade (wanting in *C. obscura*), which dentatedly margins the subterminal pale shade opposite the discal teeth of the t. p. line. Terminal field less dusky than the rest of the wing. Hind wings black, with dusky fringes, becoming white at apices. Beneath similar to *C. obscura*; the fringes on *both* wings dusky, the white bands quite narrow.

Expanse, 74 mm.

Hab. New York (in Coll. Buf. Soc. Nat. Sciences); Canada (J. Pettit).

Three coincident specimens examined. In the dark fringes to the hind wings *C. residua* resembles *C. insolabilis*; but the species is nearer *C. obscura* in its general tone, and especially in the dusky tint of the fore wings, which differ by their acutely and strongly toothed transverse posterior line.

Catocala Faustina Strecker.

♀. In the appearance of the fore wings this species resembles *C. parta*, but the basal dash and distinct apical streak are wanting, the species is but little less than one-third smaller and the hind wings are bright pinkish red as in the European *nupta*, which it more nearly resembles. The fore wings are bluish grey, and differ from *nupta*, by the greater equality of the extra discal teeth to the transverse posterior line, and by the white subreniform, closed but connected with the line, which is clouded in the European species, while their general color is brighter, more bluish grey than in *nupta*. Hind wings, with a nearly straight, nowhere excavate, black and even band. In *nupta* this is elbowed, deeply excavated externally, opposite the cell. In *C. borealis* the usual widening of the band at vein 5 is slighter than usual. The band terminates abruptly before the margin and there is no duskiness towards the base or along internal margin. Superiorly the band is notably even, not diffusely widened as in *Meskei*, from which it differs in the absence of the terminal attenuation and crooking. Marginal band as in *nupta* and allies with a broad and deep ante-terminal sulcation. Beneath, the fore wings are like *nupta*, but the bands are more even. Hind wings bright red inferiorly; the median band wider than on upper surface.

Expanse, 60 mm.

Hab. Michigan (Dr. A. S. Packard, Jr.).

Mr. Strecker's description is uncharacteristic and inaccurate; the hind wings are not "scarlet." The identification is made with difficulty, assisted by the indifferent figure in the "Lep. Het."

Anarta melanopa Thunberg.

Anarta nigrolunata Packard.

Hab. Colorado Territory (coll. Mr. Theo. L. Mead, No. 26).

I have received, through the kindness of Dr. Packard, specimens of this species, as well as of *A. melaleuca* (= *bicycla* Packard), *A. algida*, *A. funesta*, *A. quieta*, *A. amissa* and *A. leucosticta*, for comparison with the species collected in Colorado by Mr. Mead, two of which, on being compared, seem new to science.

Anarta quadrilunata Grote.

♀. Eyes hairy. Allied to *melanopa*, but differing by the fuscous, not blackish, primaries, which want the orbicular spot, and by the larger size. Fore wings pale fuscous, with the transverse anterior line pale blackish, broad and angulate. No orbicular; reniform merely a lunate black shade on the cross-vein. T. p. line of the usual shape, obsoletely lunulated. Subterminal line faint; terminal line subcontinuous. Hind wings largely whitish at base, with distinct and heavy black discal spots and broad black borders, which latter are narrower at anal angle than in *melanopa*. Beneath somewhat yellowish white, with distinct lunate spots on both wings ; primaries without subterminal line ; hind wings with the border narrower than above. Body parts with mixed whitish hair ; anus with yellowish hirsuties.

Expanse, 30 mm.

Colorado Territory (Mr. Mead, No. 24).

Anarta subfuscula Grote.

♀. Eyes hairy. In size and ornamentation of the fore wings allied to *A. Richardsoni* (*algida*), but differs by the fuscous secondaries with median line beneath. Fore wings bright grey, being a little more whitish than usual, pulverulent in appearance. All the lines distinct and continued; median shade faint, blackish; median space a little darker than the rest of the wing; ordinary spots concolorous, grey, with black annuli, moderately large, of the usual shape. Transverse posterior line lunulate, shaped much as in *Richardsoni*. Subterminal line dentate, with diffuse, blackish, irregular, triangulate, preceding shades, continued. A terminal series of black dots. The fringes are *fuscous*, with a central pale line, and obsoletely cut with greyish. Hind wings fuscous, concolorous, reflecting the discal dot and line from the under surface which, on both wings, is fuscous, paler than the hind wings above.

Expanse, 32 mm.

Colorado Territory (Mr. Mead, No. 25).

January 21, 1874.

The President in the chair. Fifty-seven persons present.

Mr. L. F. Pourtalès exhibited a specimen of *Holopus Rangii* d'Orb., belonging to Governor Rawson of Barbados, and by him lent to Prof. Agassiz for description.

It is the second specimen of this curious Crinoid known; the first one having been obtained by Mr. Rang at Martinique, about 1836, and described and figured by d'Orbigny. The original specimen could not be found in d'Orbigny's collection by Dujardin and Hupé, and doubt has been thrown on its affinities. Gov. Rawson's specimen was brought up on a fisherman's hook at Barbados, somewhat damaged, having lost four arms. It agrees in most particulars with d'Orbigny's specimen except that it has ten arms, instead of eight, and is therefore more normal. That it is a true Crinoid there can be no doubt, from the most cursory inspection, but it is of a type which can find no place in any of the known families. Figures, and a brief description of the specimen, will shortly appear among the publications of the Museum relating to the Hassler Expedition.

Mr. Pourtalès took occasion to exhibit at the same time specimens of the other Crinoids belonging to the Museum of Comparative Zoology, which now possesses all but one of the living Crinoids known, the exception being *Bathycrinus gracilis*, Wyville Thomson. The list comprises *Pentacrinus Asteria* L., *P. Mulleri* Oerstd., *P. Wyville-Thomsoni* Jeffreys, *Rhizotrochus lofottensis* Sars., *Rh. Rawsonii*, Pourt., the latter a new species, the description of which is in the press.

Mr. Pourtalès also remarked that the characters assigned by by Lütken to distinguish *P. asteria* and *P. Mulleri* are far from constant, and will require to be definitively settled by the examination of a larger number of specimens than has been possible thus far.

In concluding, he called attention to the very fine collection of fossil Crinoids from the Burlington, Iowa, carboniferous rocks, purchased by the Museum from Mr. Wachsmuth, and of which a part is now on exhibition at the Museum.

The following papers were read:—

METAMORPHISM PRODUCED BY THE BURNING OF LIGNITE BEDS IN DAKOTA AND MONTANA TERRITORIES.[1] BY J. A. ALLEN.

The "Bad Lands" of the Upper Missouri and its tributaries are replete with interest to the geologist and explorer, and though often described in general terms, one of their most important and interesting features seems as yet to have been only casually noticed. This is the presence of highly metamorphosed beds of clays and sands, accompanied by pumiceous and lava-like materials, undistinguishable in character from true volcanic products,[2] occurring over an extensive area, remote from any region of true volcanic action; this metamorphism being solely the result of the burning out of beds of lignite, and coextensive with the "bad lands" of the so-called Lignite Tertiary Formation.

This formation extends, in the United States, from near the 100th to about the 108th meridian, and from the 43d to beyond the 49th parallel, or over an area of about five hundred miles in an east and west direction and more than three hundred and fifty miles in a north and south direction. Its southern border is, however, quite irregular, being broken into by the Black Hills, between which and the Big Horn Mountains it extends southward as far as the 43d parallel. To the northward the Lignite Tertiary Formation is said to extend far into the British Possessions,[3] but I have failed to trace these peculiar phenomena of metamorphism much to the northward of the Missouri River. There is, however, an outlying district west of the main chain of the Rocky Mountains, on the Gros Ventres Fork of the Snake River. Throughout this extensive region the strata are nearly always horizontal in position, and consist of soft clays, marls and sands, with occasional beds of soft, friable sandstone, and thin bands of indurated yellowish clay, interspersed with heavy seams of lignite. Owing to the yielding nature of these materials, the streams have excavated for themselves deep channels, and the country bordering them is deeply cut by innumerable gullies and ravines, extending back often for many miles from the principal water courses, forming the well-known and almost impassable "Bad Lands" of this region. These ravines vary in depth from one hundred to three or four hundred feet, and so extensive has been the denudation at many localities, that only narrow ridges and isolated buttes, with their naked and almost vertical slopes, are left to indicate the former general level of the country. In consequence of this erosion the lignite beds are exposed at frequent points and for long distances. They vary in thickness from a few inches to six or eight, and even ten feet, and in quality from mere carbonaceous shale to that of a texture so compact and dense as to present the general appearance of cannel coal.[1] The metamorphism resulting from the combustion of these beds varies, of course, in degree and extent with the thickness of the burned out beds. Over immense areas, embracing hundreds and even thousands of square miles, the lignite beds seem, in some cases, to have been wholly consumed, all the ridges and buttes being either capped or banded with the reddened, indurated shales, that have resulted from the combustion.

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[1] The observations on which the present communication is based, were made in the summer of 1873, while attached to the North Pacific Railroad Expedition (Gen. D. S. Stanley commanding) as zoologist of the Expedition.

[2] Specimens of the metamorphosed rocks here described were exhibited to the Society, and have been pronounced by one of our highest authorities, (Dr. T. Sterry Hunt), to be undistinguishable in appearance and composition from true volcanic lavas.

[3] The great Lignite Tertiary Formation is also well-known to extend over portions of the valleys of the Saskatchewan and Mackenzie Rivers.

The metamorphosed beds consist generally of, first, a thin stratum of grayish cinders and pumiceous matter, bearing a striking resemblance to the ashes, cinders and clinkers resulting from the combustion of coal in our grates, and varying from a few inches to two feet or more in thickness. Below this layer there is only a slight discoloration and hardening of the subjacent clay. Above the bed of cinders occurs a bed of indurated clay, of a bright brick red color, varying in thickness from a few feet to twenty or more; still above this are generally several feet of indurated reddened sandstone. The whole thickness of the strata showing more or less strongly the effect of heat, may amount to thirty or even fifty feet, but the more common thickness rarely exceeds eight to twelve. Generally but a single reddened band is seen at a given point, which may extend for many miles, capping all the ridges and isolated buttes as far as the eye can reach, which hence all rise to a uniform level. Occasionally the metamorphosed beds occur at a relatively lower level, with a considerable thickness of unmodified clays and sands above the reddened beds. Again, as in the Bad Lands of the Little Missouri, and in other regions where the surface is deeply scored by erosion, several of these reddened bands are exposed, situated one above the other, separated by fifty to one hundred or one hundred and fifty feet of soft clays, marls and sands, they preserving their relative positions and almost perfect horizontality for many miles. Generally the metamorphism is limited to the hardening and change of color of the superjacent clays and sands, but where the burned out lignite beds were several feet in thickness, the strata immediately in contact with the lignite have been more or less fused or at least reduced to a more or less plastic condition. This is evident from the vitreous, porcellanic and vesicular structure of the different portions of these lower beds.

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[1] At a point on the left bank of the Yellowstone, near the mouth of Powder River, is an exposure of two heavy beds of excellent quality, separated by about three feet of soft clay shale. The lower bed has a thickness of five feet, and the upper of eight feet. On Custar's Creek, about ten miles above this point, a heavy bed is frequently exposed, with a variable thickness of six to ten feet. Exposures of this, or other heavy strata, were traced for a distance of some thirty miles, but in places had been burned out. Here, in consequence of the great thickness of the lignite beds, the metamorphism of the overlying strata extends through an unusual thickness. Similar beds probably also extended throughout the extensive metamorphic districts of the Powder River Valley, to be hereafter more particularly mentioned.

At points where this igneous action has been most intense, we find almost every variety of scoriaceous material, undistinguishable in appearance from true volcanic lavas and pumiceous matter. As already mentioned, the lowermost of the metamorphic series of beds consists of cinders and clinkers, not much unlike the residuum left in our coal grates from the combustion of ordinary coal. It is generally of a whitish or grayish color, portions of which are so soft as to be easily crumbled in the hand, or crushed under the foot; but the greater part is made up of hard, rough, vesicular masses, with the larger interstices filled in with ashy or earthy matter. The material next above this layer of cinders shows signs of having been in a plastic or semimolten condition. It presents a great variety of colors, from white, through yellowish white, olive and yellow, to dark brown, purple, and even black. The purple and olive tints are quite frequent, while the general mass is often beautifully banded with narrow zones of several of the above named colors. The texture varies from a glazed, vitreous or porcellanic, compact outer surface, and a dense, jaspery inner structure, with conchoidal fracture, to that so porous and vesicular as to float on water, while every degree of porosity between these two extremes can also be found. The vesicular portions are usually black, but are sometimes grayish, and occasionally every shade of red is presented, from dark reddish brown to bright carmine. These highly variegated beds are usually but a few inches to a foot, or perhaps a foot and a half in thickness, and are found only in certain localities where the clays before induration doubtless contained the peculiar elements that have given rise to these varieties of color. The natural surfaces usually present a glazed, waxy or vitreous, or sometimes a pearly, lustre; a fresh fracture usually has a jaspery appearance, but quite often also exhibits a waxy lustre. Above these thin, variegated beds occur the reddened, baked clays, which may present a thickness of four to twenty feet, and hence from their thickness and the universality of their occurrence form the characteristic feature of these regions of metamorphism. The color resembles that of bright red bricks, and where the material has been thinly scattered about by the gradual demolition of the buttes it once covered, the resemblance of the locality to an old long-abandoned brick-yard is very striking. These reddened beds are extremely fissile, breaking up into small, irregularly shaped splinters and fragments, and possess a metallic resonance. Nearly all these beds contain impressions of plant remains, chiefly stems and blades of broad leaved sedges and grasses, too imperfectly preserved to be of value as specimens. Occasionally, however, one meets with quite well preserved impressions of the leaves of exogenous trees. The sands that next overlie these beds of hardened clay are also generally affected to a greater or less degree, being baked into a red, coarse-grained, generally rather soft sandstone, hand specimens of which can be selected that are undistinguishable in appearance from the red sandstone of the Connecticut Valley. When the clay beds are very thick the metamorphism sometimes altogether fades out before the overlying sandy strata are reached; in other cases, where they are thin, ten to twenty feet of the superimposed sands may have been converted into a bright red, coarse, rather friable sandstone.

The quantity of explosive gases disengaged by the burning of the heavier lignite beds must of course be very great, and the pressure they must exert when thus pent up be by no means inconsiderable. In regions where the greatest intensity of igneous action has occurred, or where lignite beds of four to six or more feet in thickness have been burned out, there are frequent evidences of the breaking through to the surface of these subterranean fires. These evidences consist of jagged, chimney-like mounds of volcanic breccia that crown many of the buttes and ridges, the softer materials that surrounded them having been worn away by denuding agencies, leaving them as striking and picturesque features of the landscape. These chimney-like mounds are often circular, and but a few feet in diameter, but sometimes are prolonged into narrow walls of ragged, lava-like rock, presenting the features of a true volcanic breccia. Most of the matter composing these chimneys presents the appearance of having been forced out through small orifices or narrow fissures while in a semi-molten or highly plastic condition. In connection with these ejections there were occasionally slight disturbances of the adjoining strata, affecting sometimes an area of only a few feet in diameter, and rarely extending beyond a few yards. They were little volcanic puffs, — volcanoes, as it were, in miniature, — having their seat of action in the burning coal-seam, ten, fifteen, or perhaps fifty feet below. The molten or plastic matter in its passage often carried with it angular pieces of the adjoining strata, which, becoming consolidated with the melted mass, form the brecciated matter already mentioned. These chimneys, as before stated, are often but a few feet in diameter, and sometimes but a few feet in height. At other times they form masses ten or fifteen feet in diameter, and fifteen to twenty feet in height. They are generally irregularly scattered, and vary, in respect to distance from each other, from a few feet to fifty or a hundred yards, or even greater distances. Those occurring in the same immediate vicinity are generally of nearly the same size, some districts being characterized by small mounds of this character, others by large ones; the size being proportioned to the thickness of the lignite bed, to the burning of which they owe their existence.

Considerable portions of the matter composing these mounds is highly vesicular, or presents an eminently scoriaceous character, but often associated with it are the beautifully-variegated jaspery varieties of the igneous material already described. The heat was, of course, exceedingly intense at these points of eruption, and its effect upon the adjoining sandy strata very peculiar and interesting. The portions nearest these fissures became thoroughly molten, giving to the walls of these fissures glazed surfaces, vitrifying them to a depth varying from half an inch to several inches. The melted matter, in many cases, ran down in a viscous, semifluid state, solidifying in pendent, flowing, rounded masses, or was squeezed out through lateral cracks in the walls of the fissures and congealed in botryoidal masses while still adhering to the walls. In some cases masses occur that can be well described by comparing them to masses of molasses candy that have been pulled and folded; as they exactly resemble in structure and general appearance viscous matter that has been pulled, twisted and folded while in a plastic state. A peculiar and interesting change of structure is often presented by the sandstones immediately in contact with these highly metamorphosed masses, a cleavage oblique to the planes of stratification being induced, by virtue of which the sandstones break up into more or less regularly five or six sided prisms, half an inch to an inch or two in diameter, and one to two, and even two and a half feet in length. This prismatic structure was noticed at quite a number of localities, occurring, in fact, wherever the sandstones and these little eruptive mounds came in contact.

Usually the areas of this intense igneous action present a very broken and volcanic aspect, and a geologist suddenly transported to one of these districts would feel at first that he must be in the midst of a truly volcanic region. The blocks of scoriaceous material have in many cases rolled down from the tops of the buttes and ridges, and lie scattered in erratic masses from a single cubic foot in size to those of a ton's weight throughout the adjoining valleys, and often for some distance out on the level plain. These ragged masses of volcanic rock crowning the higher points, with the adjoining deep and abrupt ravines, combine to present quite a disturbed and chaotic appearance; yet a careful examination of even these localities shows that the strata everywhere maintain their horizontality, save the slight disturbances, of at most only a few yards in extent, already noticed. The beds of cinders underlying the metamorphosed strata point out most distinctly the cause and origin of the metamorphism and the local disturbances of the strata. Occasionally, further convincing proof that these eruptions proceeded from the burning of the heavy lignite beds, and not from deep-seated sources, is afforded by the occurrence of here and there the total removal of the mounds by denudation, which have been worn away nearly to the general level of the plateaux on which they are located, leaving only a rim ot blocks of scoriaceous matter surrounding a bare area of unaltered and undisturbed shales.

At a point on our trail, a few miles west of the Little Missouri, are some deep gorges, where the above described metamorphism may be seen on a grand scale, as also near the mouth of Powder River. At the latter locality a portion of the lignite bed still remains, and points may be found where the burning of the beds ceased, and with it the metamorphosed condition of the overlying shales. Such exposures were seen on Custar's Creek, where is a fine exposure of the junction of the burned and unburned portion of one of the heaviest beds of lignite we observed — a bed varying from eight to twelve feet in thickness. The layer of cinders was fully three to four feet in thickness, and the subsidence of the strata at the point where the combustion ceased was plainly visible.

The Bad Lands of the Little Missouri appear to present one of the most extended areas of this remarkable metamorphism that has yet been noticed. Here, with a breadth of twenty to thirty miles, these appearances are said to be continuous for fully two hundred miles. Throughout this vast area all the ridges and buttes are capped or banded with the reddened and indurated shales. This, with the generally chaotic appearance of the district, led Gen. Sully, it is reported, when he crossed it in 1864, to compare it to "hell with the fires put out." From the Sentinel Buttes, two high points situated about twenty miles west of the Little Missouri, and nearly on the boundary of Dakota and Montana Territories, the Bad Lands of the Little Missouri can be overlooked; the position of these buttes being just to the westward of the western border of this great igneous district. It terminates quite abruptly along a line running nearly north and south, so that to the eastward is one vast expanse of red undulating surface, as far as the eye can see; at this distance only the bare verdureless crests of the red-capped buttes and ridges being visible. The view is, hence, one of utter barrenness, yet wild and picturesque. A sea of fire, with its billows "fixed and motionless," is the simile at once suggested as mile upon mile of this reddened district meets the eye.

Other areas of large extent and similar appearance, when seen from a distance, also occur along the Yellowstone, near the mouth of the Powder River, along a considerable extent of Powder River itself, and also along the Rosebud and Tongue Rivers. In speaking of the country between the Rosebud and Tongue Rivers, Dr. Hayden remarks: "As we ascend this ridge, we find the country exceedingly rough, gashed up by myriads of gullies, and covered with square, conical hills eighty to two hundred feet high. A bed of yellow marl forms the summit, then a layer of lignite which has frequently ignited and baked the superincumbent yellow marl, so that the high hills are covered with a bed five to twenty feet in thickness with a brick-red rock, many of them fused. Sometimes immense masses are cemented together in large blocks of nearly baked material. The melted material varies in character from a light vesicular to a hard, compact rock. . . . . . Descending into the valley of the Rosebud, we encounter the same rugged country, with indications of the burning out of the lignite beds and the fused and semi-fused material covering the hills, giving them a peculiarly picturesque, reddened appearance. Numerous seams of lignite occur more or less pure," etc.[1] Speaking of the same ridge nearer the mountains, he says: "The summits of the ridge present a beautiful red appearance from the burning out of lignite beds." Again he says: "As far as one can see, perhaps a distance of thirty miles, there is most abundant evidence of the burning of the lignite beds. The thick bed of lignite which occurs on the Yellowstone seems to have spread over a great area of country, and to have ignited to a great extent, giving to the surface of the country a picturesque appearance."[2] Dr. C. M. Hines, in describing the counry along the right bank of the Rosebud, near the Wolf Mountains, observes as follows: "The same general features [occur] as on Tullock's Creek, excepting that the tops of the mountains present a beautiful pink or carmine color; the surface of the hills being covered with broken and detached pieces of stone and burnt clay to the depth of forty or fifty feet. Mingled with it is sandstone, some of it in a pulverulent form, and the other portions again have a scoriated appearance. The lignite in this vicinity approaches nearly to coal, and the beds increase in depth."[3]

The most western point of the occurrence of these burned out lignite beds, east of the Rocky Mountains and south of the Yellowstone, appears to be the dividing ridge between the head of Tullock's Creek (one of the lower eastern tributaries of the Big Horn) and the sources of the Rosebud. They occur thence eastward from the Rosebud and the eastern base of the Big Horn Mountains to the Black Hills and the Bad Lands, bordering almost the whole extent of the Little Missouri, and northward throughout that part of the Yellowstone valley below the mouth of Tongue River. They have been found by Dr. Hayden on the sources of the Tongue River, within a few miles of the Big Horn Mountains,[1] and by Dr. Hines as far south as "the foot-slopes" of the same range, on the Crazy Woman's Fork of Powder River.[2] Dr. Hayden also mentions their occurrence on the extreme sources of the North Fork of the Shyenne River, near the parallel of 43° 30′, and about midway between the Black Hills and the Big Horn Range. He says, "There is near the source of the Shyenne a most remarkable series of hills of varied forms, so connected together as to form a ridge which extends far across the country from the Platte to the Big Horn River. The summits of all these hills are covered with burnt rocks in a melted or semi-melted state, and they are from 150 to 200 feet in height above the surrounding prairie."[3] In respect to the Powder River, it seems more than probable that it is bordered, like the Little Missouri, nearly its whole length by "bad lands" and these accompanying metamorphic phenomena. They have been observed on its sources, as already noted by Hines, who also speaks of their occurrence for a considerable distance above the junction of Clear Fork with the Powder River, and also on Clear Fork, on a grand scale,[4] while one of the most noteworthy localities occurring on the Yellowstone is at the mouth of Powder River.

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[1] Geol. Rep. Expl. Missouri and Yellowstone, p. 56, 1869.

[2] Ibid, pp. 63, 64.

[3] Ibid., p. 96.

On the Yellowstone itself, the first appearance of lignite, so far as reported, is opposite the mouth of the Big Horn,[5] while the first occurrence of the baked clays is still lower down, near the so-called Buffalo Shoals, about half way between the mouths of Tongue and Powder Rivers. At this point begins the great Powder River region of metamorphism. It was at this point that Capt. Clarke first met with the "burnt hills" in descending the Yellowstone,[6] and where also Dr. Hines first came to the "red baked clays" in his journey down the same river.[1] I find also that I have noted this vicinity as the highest point at which we met with these beds in our last season's exploration of the Yellowstone. Thence to its mouth they occur with more or less frequency, often forming the most striking features of the country for long distances.[2]

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[1] Hayden's Geol. Rep. Expl. Missouri and Yellowstone, p. 63.

[2] Ibid., p. 97.

[3] Ibid., p. 73.

[4] Hines, in Hayden's Rep. op. cit., p. 96.

[5] Hines, Ibid., p. 102.

[6] Lewis and Clarke's Exped., (Am. Ed.), Vol. II, p. 393.

Leaving the Yellowstone and proceeding eastward to the Missouri, between the parallels of 46° and 47°, these reddened beds only occur as the capping of isolated and often widely separated buttes, till one approaches the Bad Lands of the Little Missouri. Crossing this belt of igneous action, already sufficiently described, the traces of this metamorphism suddenly almost wholly cease, but occur still eastward, at widely separated localities, to within about one hundred miles of the Missouri. To the eastward of the Little Missouri Bad Lands, however, these brick-like materials form but a thin capping to a few low mounds, where the scattered fragments of the reddened clay-chips resemble not a little the débris covering the sites of abandoned brick-yards. Mixed with the brick-like materials are fragments of scoria and pumiceous matter, while pieces of pumice stone are occasionally met with thence eastward to the Missouri, and I gathered specimens at Fort Rice so light as to float in water.

Fragments of pumice stone have been found on the Missouri as far south as the vicinity of Fort Pierre, and by the early explorers were supposed to be the products of unknown volcanos situated near the Rocky Mountains. Lewis and Clarke first met with "pumice stone" near their winter quarters on the Missouri, about fifty miles above the mouth of Heart River, to which they refer as follows: "Captain Clarke passed along the points of the high hills, where he saw large quantities of pumice stone on the foot, sides and tops of the hills, which had every appearance of having been at some point on fire."[3] Mr. I. N. Nicollet, in his exploration of the Upper Mississippi in 1839, ascended the Missouri as far as Fort Pierre, where he appears to have heard of these appearances of metamorphism and of the "smoking hills"; but he seems not to have actually seen them himself. Alluding to the smoke that had been seen to issue from some of these hills, he says: "The observance of this phenomenon, associated with the frequent recurrence of a peculiar light and spongy stone that the Missouri carries down and strews along its shores, and which has been mistaken for pumice stone, has led to the often controverted opinion that there was a volcanic region on the Upper Missouri. There are, however, no *true* volcanos over any portion of the United States east of the Rocky Mountains ; and it was this belief that led me to the adoption of the word *pseudo-volcano.* Neither is the substance found in these regions, and commonly called pumice, a true pumice ; and, by a similar analogy to that which has prompted the name of its probable origin, I have called it a *pumiciform* stone (*roche pumiciforme*)."[1]

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[1] Hayden's Geol. Rep. Expl. Yellowstone and Missouri, p. 103.

[2] As high up as the mouth of the Rosebud, the pebbles in the bed of the Yellowstone consist largely of scoriaceous matter and indurated shales, brought down doubtless by its eastern tributaries, probably the Tongue and Rosebud Rivers.

[3] Lewis and Clarke's Expedition, (American Ed.), Vol. I, p. 173.

Lewis and Clarke note the appearance of these phenomena at intervals from their winter camp already mentioned, nearly up to the mouth of the Judith River, or for a distance of not less than five hundred miles. The country at the mouth of Miry Creek (*Muddy River* of recent maps) they describe as follows : "The hills along the river are broken, and present every appearance of having been burned at some former period ; great quantities of pumice stone and lava, or rather earth, which seems to have been boiled and then hardened by exposure, being seen in many parts of these hills, where they are broken and washed down into the gullies by the rain and melting snow."[2] Twelve miles further on they "reached the lower point of a bluff on the south, which is in some parts on fire, and throws out quantities of smoke which has a strong sulphurous smell, the coal and other appearances in the bluffs being like those described yesterday."[3]

Again at a point about forty miles above the Little Missouri they observe: "The appearances of the minerals continue as usual. . . . . There is indeed reason to believe that the strata of coal in the hills cause the fire and appearances which they exhibit of being burned. Whenever these marks present themselves in the bluffs on the river, the coal is seldom seen; and when found in the neighborhood of the strata of burnt earth, the coal with the sand and the sulphurous matter usually accompanying it, is precisely at the same height and nearly of the same thickness with those strata."[4]

At the end of the next day's journey they remark: "We had travelled twenty-eight miles through a country similar to that of yesterday, except that there were greater appearances of burnt hills, furnishing large quantities of lava and pumice stone, of the last of which we observed pieces floating down the river, as we had previously done as low down as the Little Missouri."[1] These appearances continue to be noted by these observers as far as the Yellowstone. At the mouth of Martha's River, a little above the Yellowstone, they remark: " There are greater appearances of coal than we have hitherto seen, the strata of it being in some places six feet thick, and there are strata of burnt earth, which are always on the same level with those of the coal."[2] A little below Porcupine River they speak of the hills as having " become lower, and the strata of coal, burnt earth and pumice stone " as having " in great measure ceased, there being in fact none to-day."[3] A little further on, at a point some thirty or forty miles below the mouth of Milk River, they again refer to the entire cessation of these appearances.[4] At Teapot Island, some distance above the Musselshell, however, the appearance of coal and pumice stone is again noticed.[5] About Elk Rapids, and thence nearly up to the mouth of the Judith River, the continued " appearance of coal, burnt earth, pumice stone, salts,"[6] etc., is noted, beyond which is no mention of these phenomena. It hence appears that these metamorphic phenomena begin on the Missouri at a point some distance below Fort Berthold, probably near Fort Clark, and extend thence, with occasional interruptions, nearly to the Judith River ; that near Fort Berthold, between the mouths of the Little Missouri and Yellowstone, and between the Yellowstone and Elk Prairie Creek, and also at a locality some distance above the Musselshell, are districts where the metamorphism produced by the burning out of the lignite beds forms a striking feature in the topography of the country. Both above and below the Musselshell for a considerable distance, owing to an extensive outcrop of the cretaceous beds at this point, none of this metamorphism appears to have been observed.

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[1] Nicollet's Rep. on the Hydrogr. Basin of the Upper Mississippi River, p. 39, 1843. (Sen. Doc. 237, 26th Congress, 2d Session.)

[2] Lewis and Clarke's Exped., Vol. I, p. 180.

[3] Ibid., p. 181.

[4] Ibid., p. 189.

Dr. Hayden has reported the occurrence of one locality of this metamorphism west of the main chain of the Rocky Mountains, on the

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[1] Lewis and Clarke's Exped., Vol. I, p. 190.

[2] Ibid., p. 201.

[3] Ibid., p, 203.

[4] Ibid., p. 208.

[5] Ibid., p. 229.

[6] Ibid., p. 230.

Gros Ventres Fork of the Snake River. In describing this locality, he says: "To-day the tertiary strata begin to assume a good deal of importance. We have the brick-like materials which result from the burning out of the lignite beds. There were also masses of indurated clay, covered with vegetable remains and impure lignite beds; indeed, all the indications which the lignite tertiary beds present on the east side of the mountains."[1]

How far to the northward of the Missouri River these burned out lignite beds extend, I have been unable to determine. That they do not extend far in this direction seems probable, from the fact that no mention is made of them in any reports of the surveys of the 49th parallel; neither does Hind refer to them in his report of the geology of the Assiniboin and Saskatchewan Rivers. The valley of the Musselshell, and the dividing ridge between the Musselshell and Yellowstone, is apparently all cretaceous, and these metamorphosed beds are hence limited to the vicinity of the Yellowstone River; neither do they occur in the valley of the Yellowstone above the mouth of Tongue River. As already noticed, their western limit, in the basin of the Yellowstone, is the dividing ridge between the tributaries of the Big Horn and Rosebud Rivers, while they extend southward along the eastern base of the Big Horn Range to the sources of the Shyenne, and thence eastward to the Black Hills and the valley of the Little Missouri. They appear to occur not only along this river throughout nearly its whole extent, but along all the tributaries of the Yellowstone east of the Big Horn.[2]

The time during which this peculiar metamorphism has been acting extends back to a very remote period, this igneous material, in a water-worn state, occurring in the drift that covers the general surface of the country, often many miles from the nearest seat of metamorphic action, as well as in the terraces that border the larger streams. Hence it must have begun anterior to the close of the drift period, its beginning antedating the terrace epoch; and that it still continues there is abundant evidence.

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[1] Hayden's Rep. Geol. Expl. Missouri and Yellowstone, p. 86.

[2] Pumice stone, it is well known, occurs in isolated, erratic fragments in Colorado, near the base of the Rocky Mountains, and it hence becomes an interesting question to ascertain whether it originated in the lignite region to the northward, or in the volcanic districts of Montana, or whether the lignite beds in Colorado have not at some points also been on fire, giving rise to these materials. The question may perhaps also arise as to whether the volcanic fragments in the terraces of the Yellowstone and its tributaries did not perhaps come from the volcanic district to the westward. From the appearance of the materials, however — the baked clays as well as the scoriaceous matter — I had not, while on the ground, any doubt of their being formed by the burning out of the lignite beds of the immediate vicinity in early post-tertiary times.

Of the explorers who have visited this region, Lewis and Clarke appear to have been the first who gave any intelligible account of these interesting phenomena. They not only described in considerable detail the appearance of these metamorphic materials, as the preceding quotations from their narrative have already shown, but correctly ascribed their origin to the combustion of the coal beds of this region, being guided in part to this decision, doubtless, by finding some of them actually on fire. Nicollet, in his account of his journey up the Missouri, in 1839, refers to these burning coal beds, but he seems not to have seen them himself, and his knowledge concerning them was in some respects vague and erroneous, and his theories respecting their origin rather visionary. He says:

"I have now reached the proper place to treat of a very interesting phenomenon observed in the midst of this cretaceous group. It manifests itself by the occasional appearance of a dense smoke at the top of some conical hill, or along a line of country bounded by the horizon, so as to awaken the idea of distant volcanoes; hence, I have chosen to call them *pseudo-volcanos*. The smoke from these hills and the crevices in the plastic clay, is said to last at the same spot for a long time — say two or three years; indicating at them a large accumulation of combustible materials. It is not, to my knowledge, accompanied by luminous vapors, and is silently wafted along the valley, which it mournfully shrouds." "Before proceeding to account for the appearances and circumstances attending these smoking hills," he continues, "I must add a few more facts concerning their traditional and recorded history. There were none when we ascended the Missouri, in 1839; and so would seem to have been the case at the passage of Lewis and Clarke at the beginning of this century.[1] But previous to my arrival, since the memorable expedition last referred to, and during a period of three years, they were seen (as my information goes), by many intelligent persons engaged in the fur trade, all of whom are naturally observant, and most of them of unquestionable authority. I have no doubt, therefore, of the existence of these hills." "I believe," he says further, "and it is also the opinion of my friend, Prof. Ducatel, to whom I submitted my specimens, that these pseudo-volcanic phenomena may be compared with those described as occurring in other parts of the globe, under the name *terraines ardens*; although they are not here accompanied by the emission of flames." [1]

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[1] An error. See Lewis and Clarke's Exped. Vol. I, p. 181.

Vague rumors of burning coal beds on Powder River seem to have been a long time current before their existence was positively established by the visits of scientific observers. Lieut. Warren, in 1858, in a letter to the Hon. Geo. W. Jones, relating to his exploration of Nebraska,[2] thus alludes to them: "Everywhere throughout this [the lignite tertiary] formation, beds are to be found sometimes of a thickness of six and seven feet, and those on Powder River are said to be still on fire over large areas, and in many places are entirely burned out." They seem, however, to have been first described by Dr. Hines, who visited them in 1859, while attached to General Raynold's expedition. The locality is the Clear Fork of Powder River, and he describes it as follows: "Eight miles below our yesterday's camp we discovered the stratum of coal [3] (lignite) on fire. Considerable smoke issued therefrom, having a strong sulphurous smell. The heat at this point was so intense that we could not stand within twenty feet from whence the smoke issued. A thick layer of sandstone lying immediately above it, four feet, was completely calcined. From this point, at the same elevation, to some distance below the mouth of Clear Fork, I noticed the red color given to the banks by the burning out of the coal bed. Here and there were portions that had escaped. The origin of the fire I was unable to account for, unless it contains within itself the elements of spontaneous combustion." [4]

Lieut. Maynadier also makes brief reference to the same locality,[5] and Gen. Raynolds speaks of Powder River as deriving "its name from the sulphurous vapors rising from the burning beds of lignite." [6]

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[1] Rep. Hydrogr. Basin Upper Mississippi, pp. 39, 40.

[2] Letter (an 8vo pamphlet, pp. 15), p. 6, Jan. 29, 1858.

[3] A bed six feet thick, and of excellent quality, "somewhat resembling Cumberland coal," exposed for a long distance on Clear Creek, near its junction with Powder River.

[4] Haydens' Rep. Geol. Expl. Yellowstone and Missouri, p. 96.

[5] Raynold's Rep. of the Exploration of the Yellowstone River, p. 8, 1868.

[6] Ibid., p. 129.

Dr. J. P. Kimball, Chief Medical Officer of the Northern Pacific Railroad Expedition of 1873, described to me a locality he visited a few years since near Fort Berthold, where a lignite bed had burned in for a distance of fifty yards and was still on fire. The ground was considerably heated, and the overlying clays baked and reddened. Lieut. P. H. Ray, Chief Commissary of the same Expedition, informed me of a similar locality on the Little Missouri, some fifty miles above where we crossed it, which he visited in 1871. He camped on it and found the ground quite warm, although it was late in the season and the weather very cold.

From other reliable sources I have received additional accounts of beds seen in a state of ignition, and some smokes we saw in July on our right as we crossed the Little Missouri Bad Lands, and supposed at the time to be signal fires of the Sioux, were afterwards attributed to burning beds of lignite.

The origin or cause of these subterranean fires seems somewhat obscure, but it is evident that they must have arisen from more than a single cause. Several instances are well known of the lignite beds having taken fire from the burning of the prairie grass by the Indians; in some cases these fires lasting for several years. On Heart River the lignite beds exposed in the banks of the stream are said to sometimes take fire in this way, and to burn until a rise of the water reaches the exposure and extinguishes the fire. It is also probable, as suggested by Dr. Hines, that the lignite beds contain in themselves the elements of spontaneous ignition, and that in earlier times the fires may have originated in this way. The slopes of the buttes and ridges in which the lignite seams are exposed are usually destitute of vegetation, being in most cases almost vertical, so that it seems in many cases highly improbable that the fires could have reached them from the burning of the adjacent prairies. The theory of Mr. Nicollet, that these fires may be due [" *are evidently due*," he writes] "to the decomposition, by the percolation of atmospheric waters to them, of beds of pyrites, which, reacting on the combustible materials, such as lignites and other substances of a vegetable nature in their vicinity, give rise to a spontaneous combustion "[1] may not be wholly improbable.

It is well known that beds of true coal, when once ignited, will burn for many years, the fires penetrating to a great depth into the earth, as has happened in the great coal fields of Pennsylvania, of England, Germany and elsewhere. Although it seems almost impossible that a sufficient supply of oxygen to support combustion could reach these fires, it is well known that they are in reality exceedingly difficult to extinguish, and that they will smoulder for years when every effort has been made to smother them by closing every communication with the external air. I have, however, met with no account of any extended metamorphic action attending these burning coal seams such as always attends the burning of the lignite beds of the Upper Missouri country. This difference is doubtless owing to the different condition of the enclosing shales of the true coal and the lignite beds. In the former the strata are usually already indurated, and are not readily modified by heat; in the latter they consist of soft clays and sands, which are easily influenced by heat, speedily becoming baked and reddened when exposed to great heat, like the brick-clays when subjected to heat in a brick-kiln. As an illustration of how readily these clays become indurated by even moderate heat, I may mention a familiar incident of camp life. Owing to the violence of the winds in the region under consideration, it is often necessary to build the camp-fires in little pits to protect them from the wind, when the walls of these pits, after exposure to the fire for but a single day, become indurated to a considerable depth.

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[1] Nicollet's Rep. Hydrogr. Basin Upper Mississippi, p. 40.

An apparently similar combustion of coal-seams in the Celestial Mountains has been described by Semenof,[1] and in the mountains of the Upper Zaraphan and the Tian Shan ranges by Severkof,[2] the earlier, vague descriptions of which led Humboldt to suppose these regions were seats of volcanic action.

The influence of the metamorphism above described upon the topography of the country where it occurs is by no means slight. Not only do the baked, indurated clays and sands give their own prevalent bright red tint to the landscape, but they arrest or greatly retard the erosion of the buttes and ridges whose summits they compose. Over areas of thousands of square miles in extent they thus in great measure determine the surface contours, and protect the hills from an otherwise rapid demolition by the agency of aqueous denudation.

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[1] Journ. Roy. Geog. Soc., Vol. XXXV, p. 213.

[2] Ibid., Vol. XL, pp. 395, 396. Also quoted in *Nature*, by Howarth, Vol. IX, p. 142.

Dr. T. M. Brewer remarked on some noticeable cases of supposed Hybridism.

Hybrids among the various forms of the duck tribe are by no means of rare occurrence, and in several instances have been described as new species. The specimens described by Audubon as *Anas breweri*, the like of which has never since been obtained, is presumed to have been a cross between the wild Mallard and the Gadwell, or grey duck (*Chaulelasmus streperus*). Several remarkable cases of hybridism, where the evidences of the parentage on both sides are well marked, have been recorded with great care. In a very large proportion of these the common Mallard figures as one of the parents.

Somewhere about the year 1843, in company with my friend Prof. Baird, I found a race of ducks of uncommon size in a farm-yard in Carlisle, Pa. They were said to be, and their appearance tended to confirm the statement, a cross between a male Canvass-back and a female tame Mallard. The race was quite as productive as the pure, unmixed Mallard, and existed at that time in several generations, preserving with a remarkable degree of uniformity the marking of their origin. Some of these were imported into Massachusetts ; but, although at first they promised well, the breed is lost. Whether it is still preserved at Carlisle, I do not know.

A second instance is one more involved in doubt as to the reality of its being a case of hybridism. Yet that it is one appears to be a very general impression. Under the name of the Green-backed Mallard, *Anas maxima*, Gosse described a wild duck shot near Savanna-le-Mar, in the island of Jamaica. Mr. G. R. Gray, after inspecting the specimen, pronounced it to be a hybrid. Against this judgment, Mr. Gosse, however, contends. His reasons for regarding it as a good species are, that it is a not uncommon kind in Jamaica, and is one well known to the negro gunners, — that others precisely similar have been known to occur in the neighboring waters, and that this identical variety was known and described more than a hundred years ago. Mr. Gosse quotes from a MS., which states that a Mr. Thistlewood shot, Nov. 19th, 1753, a duck identical with his specimen. The duck described by Gosse as *Anas maxima* weighed four and one fourth pounds. Its head and neck is a velvety purple, changeable to sea-green. The other colors are a rich chocolate with purple reflections, and purple-brown with brilliant green reflections, and a demi-collar of pure white.

This same form has since been obtained by Mr. Bell, near New York, and by him described as *Fuligula viola.* The opinion has been expressed, perhaps on insufficient ground, that this remarkable duck is a cross between the Mallard, *Anas boschas*, and the Muscovy, *Cairina moschata.* Mr. George N. Lawrence, who includes this as a species in his list of the Birds of New York, does not regard its being a hybrids, as established by the evidence. He objects that this form is always a wild bird, and cannot therefore well originate from the Muscovy, which is not found wild north of Mexico. In all that have been seen, there is a remarkable uniformity of coloration somewhat resembling the Mallard, but not in any respect like the Muscovy Duck. The bill is the bill of an *Anas*, and not of a *Cairina.* Mr. Lawrence is quite sure that a mongrel breed, between the domestic duck and the common Muscovy would, in all instances, show unmistakable marks of the latter parentage. He thinks, therefore, that the Muscovy must be rejected from its parentage, and urges that no other presents itself of which the product could be so large. A pair shot a few years since late in November, at South Hempstead, Long Island, is in Mr. Lawrence's possession. The male weighed six and one-fourth pounds, and the female four and three-fourths.

Two years since I purchased from Hon. Arthur W. Austin, of West Roxbury, for the Mount Auburn Cemetery, three ducks, one male and two females, of what is known among bird-fanciers as the Cayuga Lake Duck. It is not a common bird, yet is by no means unknown to bird-fanciers. This flock of three has been increased to nine at Mount Auburn, and all of the additions are exactly like their parents. They are very gentle and tame, but will not permit any intercourse with them on the part of the other ducks, either Muscovy or Aylesbury. Unfortunately the drake died and the flock has only a single young drake, and the past season nearly all the eggs proved unproductive.

The drake that died combined in a remarkable degree the characteristic peculiarities of the male Mallard and the female Muscovy. It has the bill, the glossy green, with purple reflections, on the head and shoulders, of the male Mallard, with the curling tail feathers found in no other duck — unless the *maxima* be admitted to be a good species,— than the Mallard, and the black body and large size of the Muscovy. It wants the white wings of the wild Muscovy, and has a breast that properly belongs to neither parent. The origin of this hybrid is not known. Individuals of this race are known to attain the weight of eight pounds each.

That a variety so obviously a hybrid should thus be known to reproduce itself with so much exactness, may perhaps be taken into consideration in connection with *Anas maxima*. It is very different in plumage from that bird, and so far is suggestive that the origin of the latter, if a hybrid, must have been different. But its remarkable reproduction of children of uniform coloration with their parents is also suggestive that the *maxima* may, after all, have been a wild hybrid of some unknown origin, and in like manner able to reproduce its own peculiar combination of form and colors. Nor is it safe to argue that its size necessarily proves an original parentage as large as itself. The race of hybrids between the Canvas-back and the Mallard, in Carlisle, was nearly twice the size of either parent, and this is equally true of the Cayuga.

Section of Entomology. January 28, 1874.

Mr. H. K. Morrison in the chair. Eleven persons present.

The following paper was read:—

Catalogue of the Coleoptera of Mt. Washington, N. H., by E. P. Austin; with Descriptions of New Species, by J. L. LeConte, M.D.

In the summer of 1870 I visited Mt. Washington for a couple of days, but became convinced that the favorable season for collecting Coleoptera there was much earlier than the middle of August, as very few beetles were to be seen.

Last summer I had an opportunity to go again, and started earlier, though not as soon as I desired, and, as I believe, two weeks late for the best collecting. I reached the mountain on the 19th of July, camping a short distance below the Half-way House, as Mr. Sanborn's old camp among the rocks appeared too bleak, and was on the mountain just ten days; about half of that time it was too rainy to collect.

As the collections made embrace so many species, I think it would be interesting to present a list of them to the Section, and, at the suggestion of friends, I have added all the species which I have been able to learn have been found in the vicinity. The materials for this have been a collection by Mr. S. H. Scudder, a list of species taken near the foot of the mountain, by Mr. S. Henshaw, and a list of White Mountain species from Mr. G. D. Smith. To all species not taken by myself I have appended the name of the authority. I regret not to have been able to see Mr. Sanborn's collection, which would doubtless have added quite a number of species, but hope at some future time to be able to present a more complete list, and with a view of making it as perfect as possible, I shall be much obliged to any one possessing Coleoptera from Mt. Washington to send me a list, or the specimens themselves for determination.

I am under obligations to Mr. Ulke, of Washington, D. C., for assistance in determining the species, and especially to Dr. LeConte, who determined a number of species sent for that purpose, and made descriptions of a number of new species which will be found at the end of this list.

Species referred to in the descriptions are marked with an asterisk.

CICINDELIDÆ.

Cicindela longilabris Say. One specimen in 1870, about two-thirds up the mountain.

Cicindela vulgaris Say. (Scud'r.)

" *12-guttata* Dej.

" *ancocisconensis* Harr. (Smith.)

CARABIDÆ.

Notiophilus sibiricus Mots. Not rare under moss and small stones near the summit.

Nebria suturalis Lec. Near the summit, under stones, rare.

Nebria sahlbergii Fisch. Under stones near the summit and along the streams.

Nebria pallipes Say. With the last, but much more abundant.

Calosoma frigidum Kb. Near the summit.

Carabus serratus Say. (Foot of mountain, Henshaw.)

Carabus chamissonis Fisch. Not common, under stones, near the summit. I have also seen a specimen from Mt. Desert, Me., and it may doubtless be found on all the higher peaks in New England. Specimens taken in July had probably wintered in the perfect state, as it was taken much later, quite immature in 1870.

Lebia pumila Dej.

Cymindis unicolor Kb. Mountain streams, rare.

Cymindis cribricollis Dej. (Foot of mountain, Henshaw.)

Calathus ingratus Dej.

" *mollis* Schaum. Rare, near summit.

Platynus sinuatus Dej.

" *bicolor* Dej.

" *cupripennis* Dej.

" *ruficornis* Lec.

" *obsoletus* Say.

" *octocolus* Mann, *stigmosus* Lec.

Pterostichus honestus Say.

" *coracinus* Newm.

" *punctatissimus* Rand. Several specimens taken under chips and bark in the woods, near the Half Way House.

Pterostichus lucublandus Say.

" *luczotii* Dej. Common under stones.

Pterostichus hudsonicus Lec. Common.

Pterostichus mandibularis Lec. Common.

Amara hyperborea Dej. Decidedly the most abundant species under stones; specimens were also taken on grass, apparently eating it.

Amara similis Kb. Only a few specimens taken; it was much more common in 1870.

Eurytrichus piceus Lec. (Foot of mountain, Henshaw.)

Bradycellus cognatus Gyll.

" *cordicollis* Lec.

Harpalus pleuriticus Kb.

" *laticeps* Lec. (Foot of mountain, Henshaw.)

Stenolophus conjunctus Say.

Patrobus tenuis Lec.

" *rugicollis* Rand. (=*angicollis*, a misprint which has been perpetuated in all lists and notices since published.) Rare.

Trechus micans Lec.

Bembidium simplex Lec.

" *scopulinum* Kb., *gelidum* Lec.

Bembidium nitens Lec.

" *versicolor* Lec.

" *cautum* Lec. (Known before only from Colorado.)

Bembidium mutatum Gemm., *axillare* Lec.

Bembidium 4-maculatum Linn.

The above species of Bembidium were nearly all taken along the streams, and as no special pains were taken to collect them, several other species may have been overlooked.

DYTISCIDÆ.

Hydroporus niger Say.

" *lacustris* Say.

Laccophilus maculosus Germ. (Scudder.)

Acilius fraternus Harris.

Rhantus binotatus Harris.

Gaurodytes lecontei Cr., *discolor* Lec.

Gaurodytes parallelus Lec. In the mountain streams, common. All the other species were from pools near the summit.

GYRINIDÆ.

Gyrinus sp. (Scudder.)

HYDROPHILIDÆ.

Hydrobius fuscipes (Linn.)
Cercyon sp.

STAPHYLINIDÆ.

Homalota 2 sp.
Tachinus sp.
Tachyporus jocosus Say. var.*
Boletobius 2 sp.
Quedius sp.
Baptolinus melanocephalus Nord.
Pæderus littorarius Grav.
Dianous nitidulus Lec.*
Stenus sp.
Oxyporus 5-maculatus Lec.
Ancyrophorus planus Lec. In moss, along streams, abundant.
Anthophagus verticalis Say. Rare in same localities.
Lesteva pallipes Lec. In moss, rare, found quite abundantly on Mt. Tom, Mass., in similar situations.
Olophrum sp.
Micrœdus austinianus Lec*. In moss, along streams, not rare.
Anthobium dimidiatum Mels. On flowers in the greatest abundance.
Anthobium n. sp.

Besides the above, quite a number of Staphylinidæ were taken, which have not yet been determined.

PSELAPHIDÆ.

Decarthron abnorme Lec. Near the foot of mountain.

SILPHIDÆ.

Silpha marginalis Fabr. (Henshaw.)
Anisotoma alternata Lec.
" *indistincta* Lec.
Liodes globosa Lec.
Agathidium exiguum Mels.
" *pulchrum* Lec. [previously known only from California. Leconte.]
Brathinus nitidus Lec. In drift wood on the mountain streams, not rare.
Brathinus varicornis Lec. With the preceding, one specimen.

SCAPHIDIIDÆ.

Scaphisoma terminatum Mels.

ENDOMYCHIDÆ.

Phymaphora pulchella Newm.

CUCUJIDÆ.

Cucujus clavipes Fabr. Summit, one specimen.

NITIDULIDÆ.

Byturus unicolor Say.
Cercus pennatus Murr.
Epurœa infuscata Mäkl.
" *flavomaculata* Mäkl.*
Ips 4-guttatus Fabr. var.

COCCINELIDÆ.

Hippodamia parenthesis Say. (Smith.)

Coccinella 5–notata Say. (Scudder.)

Harmonia picta Rand.

Anisocalvia similis Rand. (Sm.)

Anisocalvia 12–maculata Gebl.

Psyllobora 20–maculata Say.

Hyperaspis signata Oliv.; *normata* Say. (Scudder.)

BYRRHIDÆ.

Simplocaria metallica Er. One specimen taken at the summit It was found in the greatest abundance under stones near the six-mile mark, on the carriage road, in August, 1870, but not a single specimen was to be found in the same place last year, probably because it was too early.

Byrrhus geminatus Lec.

Byrrhus kirbyi Lec.? Taken quite abundantly under stones, near Willis' Seat.

Cytilus varius Fabr. var. Same locality as above.

LUCANIDÆ.

Platycerus depressus Lec. (Scudder. Henshaw.)

SCARABÆIDÆ.

Aphodius fimetarius Linn. On carriage road, near summit.

Aphodius fossor Linn. (Smith.)

Geotrupes splendidus Fabr. (Henshaw.)

Phyllophaga fusca Fröhl. (Henshaw.)

Trichius affinis Gory. On flowers, not common.

BUPRESTIDÆ.

Dicerca lurida Fabr. (Scudder.)

Ancylochira maculiventris Say.

Melanophila longipes Say.

" *fulvoguttata* Harr.

Chrysobothris dentipes Germ.

" *trinervia* Kb.

" *scabripennis* Lap. (Scudder.)

Agrilus torpidus Lec. One specimen from the west branch of Peabody River, near foot of mountain.

ELATERIDÆ.

Epiphanis cornutus Esch.

Cryptohypnus sanborni Horn. Very abundant under stones.

Cryptohypnus abbreviatus Say.

" *lacustris* Lec.

Elater apicatus Say.

" *luctuosus* Lec.

" *pedalis* Cand.

" *pullus* Cand.

" *mixtus* Hbst.

Agriotes limosus Lec.

Dolopius pauper Lec.

Campylus denticornis Kb. Several specimens flew into my camp in the early part of the evening. A single specimen was taken under a stick.

Oestodes tenuicollis Rand. Near foot of mountain.

Eanus costalis Payk.; *vagus* Lec. On flowers, rare.

Eanus estriatus Lec. On flowers, rare.

Eanus pictus Cand.; *maculipennis* Lec. On flowers, rare.

Sericosomus incongruus Lec. On flowers and at summit, common.

Oxygonus obesus Say. (Scudder.)

Corymbites virens Schr.; *kendalli* Ger. (Scudder.)

Corymbites resplendens Esch.; *ærarius* Rand. Near summit, abundant.

Corymbites fulvipes Bland?
" *spinosus* Lec.
" *insidiosus* Lec.
" *medianus* Germ.
" *triundulatus* Rand. Common.

Corymbites propola Lec.
" *hieroglyphicus* Say.
" *æripennis* Kb.

DASCYLLIDÆ.

Macropogon piceus Lec. Two specimens. Heretofore known only from the Pacific coast.

Cyphon pallipes Lec?

LAMPYRIDÆ.

Cœnia basalis Newm.
Eros sculptilis Say.
" *modestus* Say.
Lucidota atra Fabr.
Photinus corruscus Linn.
" *nigricans* Say.

TELEPHORIDÆ.

Podabrus diadema Fabr.
" *piniphilus* Esch.
" *puncticollis* Kb.
" *lævicollis* Kb.
Telephorus carolinus Fabr.
" *oriflavus* Lec.*
" *imbecillis* Lec. var.
" *fraxini* Say.
" *curtisii* Kirb.
Malthodes fuliginosus Lec.

CLERIDÆ.

Clerus dubius Fabr.
" *nubilus* Klug.

PTINIDÆ.

Dorcatoma pallicornis Lec.* One specimen found running on an old stump near Half-way House.

CERAMBYCIDÆ.

Hylotrupes (*Callidium*) *ligneus* Fabr. (Scudder. " Alpine.")

Rhopalopus sanguinicollis Horn. (Smith.)

Calloides nobilis Say. (Scudder.)

Xylotrechus colonus Fabr. (Henshaw.)

Xylotrechus undulatus Say. One specimen near foot.

Pachyta monticola Rand. On flowers, not rare.

Acmæops bivittata Say. Was found in the greatest abundance on flowers in the vicinity of Willis' Seat, but not a single specimen was seen at a distance from that place. It occupied the flowers of the Mountain Ash, to the exclusion of almost all other insects; often a dozen were seen on a single bunch of flowers.

Acmæops proteus Kb. Near summit, common.

Gaurotes cyanipennis Say. (Sm.)

Leptura plebeja Rand.

" *subargentata* Kb. On flowers, not rare.

Leptura instabilis Hald. (Smith, one specimen.)

Leptura sexmaculata Linn.

" *canadensis* Fabr. (Henshaw.)

Leptura hirtella Lec.

" *proxima* Say.

" *tibialis* Lec.

" *pedalis* Lec. Very abundant.

Leptura vibex Newm. (Smith.)

" *sphæricollis* Say. Very common.

Leptura mutabilis Newm.

Monohammus scutellatus Say.

Graphisurus pusillus Kb.

Pogonocherus penicellatus Lec.

" *mixtus* Hald.

CHRYSOMELIDÆ.

Orsodachna childreni Kb. On flowers, common.

Syneta ferruginea Germ. *tripla* Say. Flowers, rare.

Adoxus vitis Linn.

Phyllodecta vulgatissima Linn.

Plagiodera tremulæ Fabr.

Luperus meraca Say.

Trirhabda tomentosa Linn.

Disonycha pennsylvanica Ill.

Crepidodera helxines Linn.; *nana* Say.

Crepidodera robusta Lec.*

Also two undetermined species.

Epithrix cucumeris Harr.

TENEBRIONIDÆ.

Phellopsis obcordata Say. One specimen under bark in the woods, near west branch of Peabody River.

Upis ceramboides Linn. (Scudder.)

Centronopus calcaratus Fabr. (Henshaw.)

CISTELIDÆ.

Isomira 4-striata Coup.

PYROCHROIDÆ.

Dendroides concolor Newm.

ANTHICIDÆ.

Nematoplus collaris Lec.

MELANDRYIDÆ.

Canifa pallipes Mels.

Scotodes americana Horn. One specimen, near summit.

Emmesa connectens Newm. Several specimens were taken at the camp, running on logs, which were burning at one end.

Prothalpia undata Lec. With preceding.

Scotochroa atra Lec.* One specimen with last.

Orchesia castanea Mels.

MORDELLIDÆ.

Anaspis nigra Hald. Flowers.
" *flavipennis* Hald. Flowers, common.
Anaspis rufa Say. Flowers, common.
Mordella scutellaris Fabr.
Mordellistena scapularis Say.

CEPHALOIDÆ.

Cephaloon lepturides Newm. On flowers, and occasionally in the woods, on moss or rocks.
Cephaloon ungulare Lec.* With the preceding.

OEDEMERIDÆ.

Ditylus cœruleus Rand. (Smith.)

PYTHIDÆ.

Pytho niger Kb.
" *strictus* Lec. (Smith.)
Salpingus virescens Lec. Summit, not rare.

CURCULIONIDÆ.

Pissodes affinis Rand.
" *dubius* Rand.
Lepyrus colon Linn. Near summit, rare.
Anthonomus erythropterus Say.
suturalis Lec.
Polygraphus rufipennis Kb.
Xyloterus bivittatus Kb.

APPENDIX, BY JOHN L. LECONTE, M.D.

Tachyporus jocosus Say; *arduus* Er.

A variety of this species, nearly black, with the prothorax dark brown towards the sides, was collected by Mr. Austin. The pubescence of the elytra and dorsal surface of the abdomen is unusually well preserved, and quite sericeous.

Dianous nitidulus sp. nov.

Black, shining, with a bluish lustre, strongly but sparsely punctured; prothorax one half longer than wide, widest before the middle, where it is rounded on the sides; disc with two vague transverse impressions, one near the tip, the other behind the middle; elytra as wide as the head, a little longer than wide, convex, with a small, oval, yellow spot just behind the middle, and nearer the side than the suture; abdomen strongly margined, finely punctured, with two long anal filaments at tip. Length, 4.7 mm.; .18 inch.

White Mountains, Oregon and British Columbia.

Remarkably different from *D. cœrulescens* and *chalybœus* by the punctuation being deep and sparse, as in *Stenus kiesenwetteri* of Europe. Otherwise it resembles *D. chalybœus*, but is more slender.

In the ♂ the sixth ventral segment is broadly and strongly emarginate.

Micrœdus austinianus sp. nov.

Black, shining, thinly clothed with fine, short pubescence, prothorax wider than long, sides and anterior angles rounded, posterior angles obtuse, disc broadly convex, alutaceous, sparsely and obsoletely punctulate, sides narrowly flattened towards the base, which is straight; elytra a little wider than the prothorax, three-fifths as long as the abdomen, outer angle rounded, sutural rectangular; rather depressed, finely punctured, with a large, ill-defined, dark brown spot extending from the base to the middle; exposed part of abdomen obsoletely punctulate, alutaceous, sides flattened. Length, 3.6 mm.; .14 inch.

Several specimens collected in the White Mountains, by Mr. Austin; it also occurs in Vancouver Island. The antennæ are about one-half the length of the body, slightly thickened externally; third joint a little longer than the second, which is equal to the fourth; sixth to the tenth subtriangular, a little longer than their width; eleventh one-half longer, oval, rounded at tip. Under surface finely punctured, legs brown.

I have established this new genus upon an insect resembling in form *Coryphium angusticolle* of Europe, as figured by Duval (Gen. Col. Europ. ii, pl. 24, fig. 120), but differing from that, as from the other genera of Omalini having subulate maxillary palpi, by the penultimate joint less swollen, being more than one-half longer than its thickness at the distal end, and by the last joint slender, and acicular, being only a little shorter; the mandibles are acute and curved at tip, armed with a sharp tooth beyond the middle. The head is much swelled beneath on each side, and the space between the gular sutures is very narrow.

Epuræa flavomaculata Mäklin, Bull. Mosc., 1853, p. 205.

A remarkable species, which has been heretofore found only in Alaska. It is easily recognized by the body being black above, with the side margin of the prothorax and elytra yellow; the latter each marked with two yellow spots near the suture, one behind the base, the other, smaller, behind the middle.

Telephorus oriflavus sp. nov.

Black, finely, scarcely perceptibly pubescent with short gray hairs; head in front of the eyes shining yellow, behind dull black, finely alutaceous; prothorax yellow, shining, with a broad black dorsal vitta, one-half wider than long; anterior margin rounded; basal margin slightly rounded, narrowly reflexed, sides nearly straight, narrowly reflexed; angles rounded, disc moderately convex; elytra not much wider than the prothorax, finely scabrous-punctate; antennæ, palpi and thighs black; tibiæ and tarsi piceous, ungues cleft; lower part slender, nearly as long as the upper. Length 6.5 mm., .26 inch.

White Mountains, Mr. Austin. The second joint is about two-thirds the length of the third. This species resembles in appearance *T. angulatus* and *lineola*, but is readily known by the head being yellow in front of the eyes.

Dorcatoma pallicornis sp. nov.

Oval convex, black, shining, uniformly finely punctulate, thinly clothed with very short pruinose pubescence; elytra with two nearly entire striæ at the sides, and an obsolete short stria behind the humerus; antennæ testaceous, first joint black. Length 3 mm., .13 inch.

One specimen; much larger than our two other species, with the punctures uniform and finer, and the pubescence shorter.

Crepidodera robusta sp. nov.

Reddish brown, shining, oblong and convex, prothorax nearly twice as long as wide. Sides narrowly margined, broadly rounded, disc smooth, basal impressions deep and strong, transverse impression distinct; elytra but little wider than the prothorax, strongly punctured in rows; antennæ rather stout, two-thirds as long as the body; second and third joints equal. Length 23 mm., .09 inch.

One specimen, White Mountains, Mr. Austin. Easily known by the robust form, the prothorax being hardly narrower than the elytra.

Scotochroa atra sp. nov.

Elongate, rather depressed, black, clothed with fine, short, prostrate pubescence; head and prothorax finely and densely punctured, the latter one-half wider than long, narrowed in front, rounded on the sides and apex; truncate feebly bisinuate and finely margined at base, which is slightly flattened each side; hind angles rectangular; elytra scarcely wider than prothorax, elongate, gradually rounded and narrowed behind, finely less densely punctured; antennæ at base, and tarsi piceous. Length 5 mm., .2 inch.

One specimen, White Mountains, Mr. Austin. An uncharacteristic looking insect belonging to the Serropalpus group of Melandryidæ, which, I regret to say, warrants on examination the founding of a new genus, allied to Carebara and Spilotus, agreeing with them in having the middle coxæ not contiguous, the maxillary palpi with the second and third joints not dilated, and the pubescence short, prostrate. It differs from the former by the smaller head, slender antennæ, and triangular, less securiform, last joint of the maxillary palpi.

The characters therefore are: Body elongate, finely punctured, clothed with fine prostrate pubescence; head rather small, eyes convex prominent, transverse, rather finely granulated; mandibles bifid at tip; maxillary palpi moderately long, last joint wider than second and third, triangular; antennæ slender, longer than head and prothorax; second joint a little shorter than third. Prothorax narrowed in front, rounded on sides, feebly bisinuate and finely margined at base. Elytra parallel, gradually rounded and narrowed behind. Legs short, feeble, tarsi slender, penultimate joint bilobed, first joint of hind tarsi as long as the others united.

A second species of this genus is indicated by a specimen from Oregon, too mutilated to permit of generic determination in my former investigations. It is in form and size similar to the species above described, but differs by the prothorax more distinctly bisinuate behind, the hind angles better defined, and by the antennæ being testaceous at base, and at the extremity of the last joint. It may be called *S. basalis.*

Cephaloon ungulare sp. nov.

Very elongate, testaceous or piceous, finely punctured and pubescent; antennæ slender, scarcely thickened externally, joints 9–11 longer, especially in the ♂, claws pectinate, with the appendage slender, curved and acute at tip. Length 11–13 mm.; .44–.50 inch.

White Mountains and Lake Superior: resembles in form *C. lepturides,* but is more slender, with the antennæ longer and nearly filiform; the claws are rather stout, and strongly pectinate as in that species, but the appendage is slender, curved and acute at tip, as in most Meloides.

I received from the Rev. A. Matthews a specimen collected in Vancouver's Island, which, on more careful examination, proves to be quite distinct; it may be known by the following characters:—

C. tenuicorne sp. nov.

Above testaceous, head behind the antennæ, sides of elytra and under surface piceous; antennæ a little longer than the head and prothorax; (♂) slender, slightly thickened externally, joints 3–7 slender, elongated (third longest), ninth and tenth shorter than eighth, wider than the preceding ones, eleventh nearly twice as long as the tenth. Length 12 mm.; .48 inch.

The appendage of the claws in this species is broad and rounded at tip, precisely as in *C. lepturides*; the form is also broader and stouter, resembling the figure of the Siberian *C. variabile* Motsch.

(Amur Reise, II, 141, tab. ix, fig. 16), and the antennæ are also similar in having the intermediate joints elongated. The fifth ventral is more strongly emarginate than in the ♂ of the other two species. The following table will serve to distinguish the three species known to me:

A. Appendage of claws broad, rounded at tip :—

Outer joints of antennæ gradually broader, not elongated. 1. *lepturides.*

Four outer joints slightly wider, joints longer, especially the intermediate ones. 2. *tenuicorne.*

B. Appendage of claws slender, curved, acute :—

Antennæ very long and slender, nearly filiform. 3. *ungulare.*

February 4, 1874.

Vice-President, Mr. R. C. Greenleaf, in the chair. Forty-four persons present.

The following paper was read : —

On Geographical Variation in Color among North American Squirrels; with a list of the Species and Varieties of the American Sciuridæ occurring north of Mexico. By J. A. Allen.

Some months since[1] I had the pleasure of calling the attention of the Society to the subject of geographical variation in size, proportions and color among North American birds, and of illustrating the subject by an exhibition of specimens. At the same time I also referred incidentally to variations of a similar character among North American mammals. As remarked on these occasions, the law of geographical variation in size with locality (representatives of the same species decreasing in size with the altitude and latitude of the locality) was satisfactorily established by Prof. Baird in 1857 and 1858, in respect to both mammals and birds. The occurrence of variations in the proportion of parts and in color at certain localities among individuals of the same species, was also at the same time brought to notice, and again alluded to by Prof. Baird in 1866. These observations led to a further examination of this interesting subject, and the discovery of hundreds of additional facts of a similar character. The instances noticed prior to 1866 proved to be by no means exceptional cases, but to be the result of other geographical laws of variation, as universal and almost as well pronounced as that of the variation of size with locality. These I have termed the laws of (1) the enlargement of peripheral parts at the southward; (2) of the increase in intensity and extent of dark colors at the southward, and (3) increase of color with increase of humidity, or the correllation of intensity of color with the mean annual rainfall.[1] I now propose to refer more especially to the variation of color with locality among the North American *Sciuridæ*, and to briefly notice some of the results that have attended a recent examination of the group.

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[1] At the meetings of April 17 and June 19, 1872.

First, in respect to the increase in intensity of color from the north southward. Among the squirrels this increase is finely illustrated in *Sciurus hudsonius* and in *Tamias striatus*, representatives of which from the southern parts of New York and Pennsylvania are much more highly colored than are those from northern New England and the British Provinces. *Sciurus carolinensis* is perhaps a still more marked example, in which the color varies from the light pure gray of the upper parts in New England specimens, with a restricted pale yellowish brown dorsal area, to the rusty gray dorsal surface of the Florida type, in which the whole upper surface is usually strongly yellowish-rusty. This increase of color southward is, however, still more strongly marked in the fox squirrels of the Mississippi Basin, the so-called *Sciurus* "*ludovicianus.*" In specimens from Ohio, Northern Illinois, Southern Michigan, Wisconsin and Iowa, the lower parts are pale fulvous, varying in some specimens to nearly white. In Southern Illinois, and at St. Louis, Mo., the color has increased to a strong bright fulvous, while in specimens from lower Louisiana the color has become reddish fulvous or deep orange. At the same time, the color of the dorsal surface becomes proportionally darker at the southward, through the greater breadth of the black annulations at the tips of the hairs, the dorsal surface in Louisiana specimens being many shades darker than in those from the Upper Mississippi. This variety also finely illustrates the variation in color seen in specimens from comparatively dry and moist regions, its habitat extending up the Missouri and its western tributaries to a point considerably above Sioux City. Beginning with Ohio specimens and passing westward, we find an increase of color in those from Northern Illinois, Wisconsin and Iowa, west of which point the color rapidly

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[1] See Bull. Mus. Comp. Zool., Vol. II, pp. 229–242, 369–375, April, 1871;—*Ibid.* Vol. III, pp. 114–119, July, 1872. Also, Proc. Bost. Soc. Nat. Hist., Vol. XV, pp. 156–159, Sept., 1872 (Communicated Apr. 17, 1872);—*Ibid.* XV, pp. 212–219, Dec., 1872 (Communicated June 19, 1872);—Amer. Nat., Vol. VI, pp. 559–560, Sept., 1872. For other reference to the subject see COUES (Dr. ELLIOTT), Proc. Acad. Nat. Sci., Phila., 1872, p. 60, July, 1872; RIDGWAY (ROBERT), Amer. Journ. Arts and Sci., 3d Ser., Vol. IV, pp. 454–460, and Vol. V, pp. 39–44, Dec., 1872, and Jan., 1873; containing a further development of the subject of geographical variation in color, and the addition of many new corroborative facts. Also the critique of Dr. Coues, on Mr. Ridgway's article (Amer. Nat., Vol. VII, pp. 415–418, July, 1873), and Mr. Ridgway's reply (*Ibid.*, pp. 548–555, Sept., 1873).

In this connection I feel called upon to notice briefly Mr. Ridgway's important paper in the American Journal of Arts and Science, and his defence of it in the American Naturalist. In respect to the original article, the general laws of geographical variation in color, previously worked out by others, are here restated without any intimation whatever that anything had been previously done on the subject. The ample apology, however, subsequently made, renders it clear that this omission was an inadvertance rather than any intended wrong, and would not be here alluded to except for its historical connection with a matter now to be noticed. In his reply to Dr. Coues' rather pointed criticism, his anxiety to exonerate himself, seems (to me, at least,) to have misled him into a somewhat unfair statement of the points at issue as respects the originality of some of my own work.

As I have felt it proper to notice this already somewhat at length in the American Naturalist (Vol. VIII, pp. 227-229, April, 1874), I need not go into details here. Suffice it to say, then, that he seems to have failed to appreciate the difference between calling attention to a few instances of variation with locality in respect to proportions and color, and their combination with hundreds of others of a similar character, and noting their correlation with differences in the physical conditions of the localities at which these variations occur. In short, I think he hardly fairly states the case when he assumes that Prof. Baird, in stating, in 1866, that the representatives of certain species of birds in Florida and Lower California had relatively larger bills than their more northern relatives, and that in several instances the *western* representatives of certain species had longer tails than their eastern relatives, anticipated my announcement in 1871 and 1872 of a law of enlargement of peripheral parts to the southward, including in birds the lengthening of the tail and claws, as well as the lengthening and enlargement of the bill (the lengthening of the tail really occurring at the *southward*, rather than at the westward); or, in stating again that the birds of the plains were apt to present a bleached or weather-worn appearance, and were darker again on the Pacific Coast, that he also anticipates my announcement of the laws of the greater intensity, depth and extent of the dark colors southward, and their increase also in depth and extent at localities varying in longitude with the increase of atmospheric humidity.

decreases in intensity, Nebraska specimens being much paler than those taken on the same parallel near the Mississippi River. Specimens from the Indian Territory are also very much paler than those from St. Louis, as are Texas ones than those from Louisiana. Even between specimens from the prairies of northwestern Louisiana and others from the lowlands of the same State, near the Mississippi River, the difference in color is very strikingly marked.

The variation in color occurring in representatives of the same species at localities differing in longitude, is well shown in quite a number of groups. But few specific forms, however, have a sufficiently wide range to illustrate the variations that obtain along a given parallel throughout the whole breadth of the continent, the *Sciurus hudsonius* group being the only instance among the squirrels. Others, however, show the transition that obtains in passing from the moist, fertile prairies of the Mississippi Valley to the dry plains, or from the deserts and mountainous districts of the interior to the moist region bordering the Pacific Coast north of the parallel of 40°. *Spermophilus tridecem-lineatus* furnishes a good illustration of the differences in color that occur between representatives of the same species living on the moist, fertile prairies and those inhabiting the dry, barren plains, those from Illinois, Wisconsin, Minnesota and Iowa being much darker than those from Western Nebraska, Western Kansas and Colorado. Even specimens from Eastern Kansas are much darker than those from the middle and western portions of the same State. In this species the color is varied, in passing from the prairies to the plains, not only by the lighter shade of the dark ground color, but by the considerably greater breadth of the light spots and stripes in the specimens from the plains. The *Spermophilus grammurus* group (composed of the *S. grammurus*, *S. Beecheyi*, *S. Douglassi*, etc., of authors) illustrates not only a similar variation in intensity of color between the inhabitants of dry and moist regions, but also a somewhat changed style of coloration. Beginning with the nearly uniformly gray or grizzled type of Texas and Southeastern New Mexico, we pass to the more rufous or reddish phase of the central portions of the Rocky Mountains (in Colorado), which also has an increased amount of hoariness on the sides of the neck and shoulders, to the form west of the Sierra Nevada Mountains, typically represent, ing the *Spermophilus Beecheyi*, in which the hoariness forms broad lateral bands separated by a narrow brown medial stripe. This form in Northern California passes into the so-called *Spermophilus*

Douglassi, which differs chiefly from *S. Beecheyi* in having the medial stripe darker, or nearly black.

But two of the most instructive and interesting groups of the *Sciuridæ*, in this connection, are those of which the common *Sciurus hudsonius* and *Tamias quadrivitatus* are respectively familiar examples, the former ranging over the northern half of the continent, and the latter extending over the western half of North America and Eastern Asia. In the *Sciurus hudsonius* group, we have at the east the well-known chickaree (*S. hudsonius*), extending westward to the Plains, and northwestward to Alaska, with its brighter and smaller southern form in the eastern Atlantic States. On the arid plains of the Platte and Upper Missouri Rivers it presents a markedly paler or more fulvous phase, well illustrated by specimens from the Black Hills. This form becomes even still paler and more fulvous at the eastern base of the main chain of the Rocky Mountains, between latitude 43° and 47°, where it begins to pass by insensible stages of gradation into the so-called *Sciurus Richardsoni* of the Rocky Mountains north of 45°, and the so called *Sciurus Fremonti* of the Rocky Mountains south of about the same parallel. In the collections made in Western Wyoming, near the Yellowstone Lake, occur many specimens which are so exactly intermediate between the three forms (*S. hudsonius, S. Richardsoni* and *S. Fremonti*) whose habitats here meet, that it is impossible to say which of the three forms they most resemble. At the same time specimens can be selected which will form a series of minute gradations from the pale form of *hudsonius* from the Plains, on the one hand, to the *Richardsoni* and *Fremonti* forms on the other. To the southward of this district we soon pass into the region of the typical *Fremonti*, and to the westward and northward into the habitat of the *Richardsoni* type. Even the country about the sources of the Gros Ventres Fork of the Snake River, is already within the range of the true *Richardsoni*.[1] The habitat of *S. Richardsoni* extends from the main chain of the Rocky Mountains, north of latitude 44°, to the Cascade Range. Here it becomes mixed with *S. Douglassi*, which scarcely differs from *S. Richardsoni*, except in being a little darker above, and in having the ventral surface more or less strongly tinged with buff, varying in different specimens from cinerous to pure buff. This form prevails from the Cascade Range to the Pacific Coast, southward to Northern California, and northward probably to Sitka. In Northern California the *S. Douglassi* meets the range of the true *S. Fremonti*, between which two forms there is here the most gradual and intimate intergradation. In this group we have hence four forms which, in their extreme phases of mutual divergence, appear as diverse as four good, congeneric species need to, but which, at points where their respective habitats join, pass into each other as gradually as do the physical conditions of the localities at which their extreme phases are developed.

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[1] While the prevailing color above in *S. hudsonius* is light yellowish-brown, varying to bright ferrugineous along the middle of the back, in *S. Richardsoni* it is dull rusty or dark chestnut-brown, and in *S. Fremonti* pale brownish-gray. The prevailing color of the tail in *S. hudsonius* is usually yellowish-rusty, varying to dark ferruginous, with broad annulations of black; in *S. Richardsoni* it is black, varied more or less with rusty; in *S. Fremonti* black varied with gray.

The *Tamias quadrivitatus* group[1] presents an equally or even more striking range of variation in color, and also varies to an unusual degree in size. Beginning at the northward, we find that specimens from as far south as Pembina, and thence northward, are quite undistinguishable from specimens from Northeastern Asia, or the so-called *Tamias* "*Pallasi*" (*T. Pallasi* Baird = *T. striatus* of most European authors). This form is found to only a limited extent south of the northern boundary of the United States, where on the plains of the Upper Missouri it passes into the blanched, pallid form of *T. quadrivitatus* (*T. quadrivitatus*, var. *pallidus* nobis,— see beyond), and further westward into the true *T. quadrivitatus* of the Rocky Mountains, and still further westward into the so-called *T. Townsendi* of the Pacific Coast. In this group the greatest pallor is reached on the plains of the Yellowstone, and in the deserts of Nevada, Utah and Arizona. In the central portions of the Rocky Mountains (Colorado and portions of New Mexico) a form is developed distinguished by its generally bright, strong colors, but especially for the rich fulvous tints of the sides of the body, to which there is but a slight tendency either in the northern form or the pallid form of the plains. Both, however, very gradually pass into the rufous-sided type, the pallid form wherever the plains approach the mountains (as along the eastern base of the Rocky Mountains, the Uintah, Sierra Nevada, and others of the more southern ranges), gradually becoming fulvous, while the darker northern form grades into the larger fulvous race of the more northern portions of the Rocky Mountains in Montana and Idaho. This larger fulvous race west of the main divide soon begins to assume a duller, more fuscous shade, deepening finally into the very fuscous form (*T. Townsendi*) of the region between the Cascade Range and the Pacific Coast. In this form the general color increases so much in depth as to become dusky yellowish-brown, and both the light and the dark stripes become obscure, and occasionally almost entirely obsolete, through the gradual accession of color. Between the extreme phase of this fuscous type and the extreme phase of the pallid type of the plains, in which the stripes are sometimes again partially obsolete through the extreme lightness of the general color, the differences are very great indeed. Yet in placing the scores of specimens I have had the opportunity of examining in a geographical series, or arranging them simply according to their localities, a most thorough and minute intergradation becomes at once apparent. The difference in size, too, between northern and southern specimens is also unusually great; the pale, southern form of the plains, and the extremely bright, fulvous form of Colorado and New Mexico, being very much smaller than the northern, darker form, or than the fuscous type of the northwest coast.

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[1] *Tamias quadrivitatus, T. Pallasi, T. Townsendi* and *T. dorsalis* of American authors.

As corroborative evidence that these varied types of coloration are but geographical races, it becomes interesting to observe that the light and dark and the fulvous and rufous forms, respectively of the different species, occur over the same areas. With the fuscous type of *Tamias quadrivitatus* occur the dark types of *Sciurus hudsonius*, and the dark-backed form of *Spermophilus grammurus*, and also a peculiar, dusky form of *Arctomys* and of *Lepus*, and a dark form of *Spermophilus Richardsoni*. On the plains occur pallid forms of *Sciurus* "*ludovicianus*," *Sciurus hudsonius*, *Tamias quadrivitatus*, and *Spermophilus Richardsoni*. With the fulvous type of *Tamias quadrivitatus* occurs a rufous form of *Spermophilus grammurus*; but the form of *Scuirus hudsonius*, occurring over the same area, presents the exceptional condition of a minimum amount of rufous.

Taking the mammals and the birds of the continent collectively, we may recognize, in a general way, at least five more or less well-marked areas characterized by certain peculiarities of color variation, and also a correlation between these areas and the prevalent tendencies of color increase and the amount of aqueous precipitation. Other lesser areas, characterized by certain peculiarities of color variation, will doubtless be recognized when the material at hand is sufficient to admit of a more detailed examination of the subject, such indications, in fact, being already more or less apparent. The first region we propose now to define is that of the Atlantic Slope, which will include not only the country east of the Alleghanies, but a large part of the British Possessions, extending westward at least as far as Fort Simpson, and thence northward and westward to Alaska, including, apparently, all of that territory north of the Alaskan Mountains, with an annual rain-fall throughout the whole of this extended region of about thirty-five to forty-five inches. Over this region (to which we may give the general term of *Atlantic Region*) the colors may be regarded as of the average or normal type, those of other regions being either of a diminished or increased intensity.

The second region will embrace the Mississippi Valley, or more properly the Mississippi Basin, and may hence be termed the *Mississippi Region.* Here the annual rain-fall reaches forty-five to fifty-five inches, and over a small area east of the Lower Mississippi even exceeds sixty inches. The tendency here is so often to an increase of fulvous and rufous tints, that we may regard this as the distinctive chromatic peculiarity of the region, these tints reaching their maximum in the limited area of greatest humidity, but a general increase in intensity of color is also more or less characteristic of the region. A third region embraces the central portion of the Rocky Mountains, and being developed most strongly within the present territory of Colorado, and being also mainly included within that territory, may be termed the *Colorado Region.* The tendency here again, as compared with the immediately adjoining districts, is to a general increase of intensity of color, with also a marked inclination to the development of rufous and fulvous tints, this region being also within the influence of a comparatively high temperature, at least in summer. The humidity is here less than in either of the other regions already defined, the annual aqueous precipitation amounting to only about twenty-four to thirty inches; but it is yet greatly in excess of that of the districts immediately surrounding it.

The fourth region may be regarded as made up of the arid plains and deserts of the great central plateau of the Continent, including not only the "Great Plains," usually so called, but the deserts and plains of Utah, Nevada, Western Colorado, New Mexico, Arizona, and southwestward to Lower California, and may hence be appropriately termed the *Campestrian Region.* The annual rain-fall is generally below fifteen inches, but ranges, at different localities, from three inches to twenty. Here a general paleness of color is the distinctive feature. The fifth region begins on the Pacific Coast at about the 40th parallel, embracing a comparatively narrow belt along the coast from Northern California to Sitka. Its peculiarities are most strongly developed west of the Cascade Range, north of 45°; they also prevail eastward nearly or quite to the main chain of the Rocky Mountains. It may hence be termed the *Columbian Region.* With an average annual rain-fall of fifty-five to sixty-five inches, the prevalent tendency in color is to dusky and fuscous rather than rufous tints. The district between the Cascade Range and the main chain of the Rocky Mountains presents features that may almost entitle it to rank as a distinct region, as might also the region of maximum rain-fall in the Mississippi Region. The southern half of Florida is also perhaps entitled to recognition as a distinct region, being characterized by excessive humidity and a subtropical intensity of color. It may also be necessary to eventually recognize as distinct districts the almost rainless portions of the Campestrian Region.

In respect to the correllation of intensity of color in animals with the degree of humidity, it would perhaps be more in accordance with cause and effect to express this law of correllation as a *decrease* of intensity of color with a *decrease* of humidity, the paleness evidently resulting from exposure and the blanching effect of intense sunlight, and a dry, often intensely heated atmosphere. With the decrease of the aqueous precipitation, the forest growth and the protection afforded by arborescent vegetation gradually also decreases, as of course does also the protection afforded by clouds, the excessively humid regions being also regions of extreme cloudiness, while the dry regions are comparatively cloudless districts.

In addition to the tendency to change of color with locality, there is another phase of color variation that requires, in this connection, a passing notice, — namely, *Melanism.* It is now well known that almost every species of mammal may be expected to present melanistic individuals, instances of its occurrence in the majority of the North American species being now well established. Indeed, the very fact of a melanistic phase of coloration may be looked upon as almost *a priori* evidence that the individuals presenting it belong to a melanistic race of some species whose normal color is some other tint than black, as Prof. Baird long since remarked in respect to the American squirrels. It has been supposed that the tendency to melanism is more prevalent at the northward; but such does not appear to be necessarily the case. Among the *Sciuridæ,* for instance, a group rather remarkable for a tendency to melanistic varieties, the black and dusky forms are as often southern as northern. In some species melanistic individuals are as rare as are the cases of albinism, as in *Sciurus hudsonius*, the species of *Tamias*, and in many of the *Spermophili*, while in others they are sometimes the common, if not the prevalent, form over a considerable area, as occurs in *Sciurus carolinensis* and *Sciurus cinereus*. Melanism is also of frequent occurrence in *Sciurus Aberti*, and in *Spermophilus grammurus*, which presents a melanistic form both in Texas and Lower California. *Spermophilus Parryi* has also a black race along the Youkon River, and frequent instances of melanism are well known in all the species of *Arctomys*. In numerous instances these melanistic individuals and melanistic forms have been described as distinct species, while in reality they are generally so sporadic in their occurrence as to render them hardly worthy of recognition, even as varieties.

The gradual increase of our knowledge in respect to the character of these melanistic forms, and especially in regard to the extent and character of geographical variation, necessarily leads to the modification of our views in respect to the status of many forms that have formerly passed current as more or less well-established species, and also to consequent changes in nomenclature. The representatives of few groups are more variable in respect to color, even among individuals of the same species inhabiting the same locality, than the arboreal squirrels. Add to this the considerable amount of geographical variation that obtains among them, and the very considerable changes attendant upon season in respect to the character of the pelage, and we shall no longer feel surprised at the profusion of synonyms that attach to many of the species. In respect to the North American members of *Sciurus*, Prof. Baird, in his excellent monograph of the group published in 1857, found it necessary to reduce the number of species from *twenty-four*, the number recognized by Audubon and Bachman in 1854, to ten well-established species and two doubtful ones, several of his own species, in this reduction, sharing the fate of those of previous authors. In undertaking recently a monographic revision of the American *Sciuridæ*, I have found it necessary to still further reduce the specific forms to *five*, recognizing, however, *seven* geographical varieties in addition, making the whole number of recognized forms *twelve*. As illustrative of the bearing of the class of facts already noticed, I subjoin herewith a synoptical rèsumè of the species and varieties of the *Sciuridæ* of North America found north of the Isthmus of Panama.[1] The synonyms cited will doubtless be sufficient to render clear the changes of nomenclature here introduced (the names of the United States species used in Baird's Mammals of North America being always given), the detailed descriptions of the forms recognized, and the discussion of their character and relations being reserved as the subject matter of the more extended memoir referred to above.

Genus SCIURUS.

1. Sciurus cinereus.

a. var. cinereus.

Sciurus cinereus Linn., Syst. Nat., I, 64, 1758.—Baird, Mam. N. Am., 248, 1857.

Hab. Atlantic States north of Virginia.

b. var. niger.

Sciurus niger Linn., Syst. Nat, I, 64, 1758. —Allen, Bull. Mus. Comp. Zool., II, 176, 1871.

Sciurus vulpinus Gmelin, Syst. Nat., I, 147, 1788.—Baird, Mam. N. Am., 246, 1857.

Sciurus capistratus Bosc., Ann. du Museum, I, 181, 1802.—Bachman, Proc. Zool. Soc. Lond., VI, 85, 1835.

Hab. Atlantic States south of Virginia; Gulf States west to Texas?

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[1] I should here state that the following rèsumè, as well as the proposed monograph, is based mainly on the immense stores of material that for many years have been accumulating at the Museum of the Smithsonian Institution, and which have been kindly placed in my hands by Prof. Baird for elaboration. In addition to this rich material, I am also permitted the use of that contained in the Museum of Comparative Zoology, which, so far as the forms of Eastern North America are concerned, far exceeds that of any other collection. The material at my command hence ranges from thirty to several hundred specimens of each of the greater part of the species of North American *Sciuridæ*. As indicative of the recent increase in the material at the Museum of the Smithsonian Institution, I may add that while in 1857 there were but two specimens of *Sciurus* "*Fremonti*" extant, I have had access to more than fifty skins, many skulls and to specimens in alcohol; the five specimens of *Sciurus* "*Richardsoni*" have been increased to forty; of *Spermophilus Harrisi*, from three to thirty-five; of *Spermophilus Richardsoni*, from none to above seventy, etc. Of *Spermophilus tridecem-lineatus* I have had before me about one hundred and sixty; of the *Sciurus hudsonius* group, upwards of two hundred and fifty; and of the *Tamias quadrivittatus* group, nearly one hundred and seventy-five, and very large and satisfactory series of nearly all the other species mentioned in the following synopsis.

c. var. **ludovicianus.**

Sciurus ludovicianus Custis, Barton's Med. and Phys. Journ., II, 43, 1806.—Baird, Mam. N. Am., 251, 1857.
Sciurus macroura Say, Long's Exped., I, 115, 1823.
Sciurus magnicaudatus Harlan, Faun. Am., 178, 1825.
Sciurus texianus, *subauratus* and *Auduboni* Bachman, Proc. Zool. Soc. Lond., VI, 86, 87, 97, 1838.
Sciurus occidentalis Aud. and Bach., Jour. Acad. Nat. Sci. Phila., VIII, 317, 1842.
Sciurus rubicaudatus and *Sayi* Aud. and Bach., Quad. N. Am., II, 30, 274, 1851.
Sciurus limitis Baird, Proc. Acad. Nat. Sci. Phila., VII, 331, 1855.

Hab. Mississippi Basin, west to the Plains.

2. **Sciurus carolinensis.**

a. var. **carolinensis.**

Sciurus carolinensis Gmelin, Syst. Nat., I, 143, 1788.—Baird, Mam. N. Am., 256, 1857.
Sciurus cinereus Schreber, Säugt., IV, 766, 1792 (nec. Linn.).

Hab. Southern Atlantic and Gulf States.

b. var. **leucotis.**

"*Sciurus pennsylvanicus* Ord, Guthrie's Geog., (2d Am. Ed.,) II, 292, 1815."
Sciurus niger Godman, Am. Nat. Hist., II, 136, 1826.
Sciurus leucotis Gapper, Zool. Journ., V, 206, 1830.
Sciurus fuliginosus Bach., Proc. Zool. Soc. Lond., VI, 96, 1838.
Sciurus migratorius Aud. and Bach., Quad. N. Am., I, 265, 1849.

Hab. United States east of the Plains, except the South Atlantic and Gulf States.

3. **Sciurus fossor.**

Sciurus fossor Peal, Mam. and Birds U. S. Exp., 55, 1848.
Sciurus Hermanni Leconte, Proc. Acad. Nat. Sci. Phila., V, 149, 1852.

Hab. Pacific Coast, from the Columbia River to San Diego; only west of the Cascade and Sierra Nevada Mountains.

4. **Sciurus Aberti.**

Sciurus dorsalis Woodhouse, Proc. Acad. Nat. Sci. Phila., VI, 110, 1852 (nec Gray).

Sciurus Aberti Woodhouse, Ibid., 220, 1852. — Baird, Mam. N. Am., 267, 1857.

Hab. Southern Colorado, New Mexico, and portions of Arizona.

Sciurus castanotus [*castanonotus*] Baird, Proc. Acad. Nat. Sci. Phila., VII, 332, 1855. — Ibid., Mam. N. Am., 266, 1857.

Hab. San Francisco Mountains.

5. Sciurus hudsonius.

a. var. hudsonius.

"*Sciurus hudsonius* Pallas, Nov. Sp. Glir., 376, 1778."— Baird, Mam. N. Am., 269, 1857.

'*Sciurus carolinus* Ord, Guthrie's Geog. (2d Am. Ed.) II, 292, 1815."

Sciurus rubrolineatus Desm., Mamm., II, 333, 1822.

Hab. North America, east of the Rocky Mountains; Alaska.

b. var. Fremonti.

Sciurus Fremonti Aud. and Bach., Quad. N. Am., III, 237, 1853.— Baird, Mam. N. Am., 272, 1857.

? *Sciurus mollipilosus* Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 102, 1841.

Hab. Rocky Mountains, south of about latitude 43°, and westward to the Pacific Coast.

c. var. Richardsoni.

Sciurus Richardsoni Bach., Proc. Zool. Soc., Lond., VI, 100, 1838.— Baird, Mam. N. Am., 273, 1857.

Hab. Western slope of Rocky Mountains, north of about latitude 44°, and westward to the Cascade Range.

d. var. Douglassi.

Sciurus Douglassi Gray, Proc. Zool. Soc., Lond., IV, 88, 1836.— Bachman, Ibid, VI, 99, 1838. — Baird, Mam. N. Am., 275, 1857.

Sciurus lanuginosus Bach., Proc. Zool. Soc. Lond., II, 101, 1838 (partial albino).

Sciurus Townsendi Bach., Journ. Acad. Nat. Sci. Phila., VIII, 63, 1839 (MS. name).

Sciurus Belcheri Gray, Ann. and Mag. Nat. Hist., x, 263, 1842.

Sciurus Suckleyi Baird, Proc. Acad. Nat. Sci. Phila., VIII, 333, 1855.

Hab. Cascade Range, westward to Pacific Coast, and from Northern California north to Sitka.

Genus SCIUROPTERUS.

6. Sciuropterus volucella.

a. var. volucella.

"*Sciurus volucella* Pallas, Nov. Sp. Glir., 351, 353, 359, 1788."

Pteromys volucella Desm., Mamm., II, 343, 1822: — Baird, Mam. N. Am., 286, 1857.

Hab. North America, south of about the isotherm of 40° F.

b. var. hudsonius.

Sciurus hudsonius Gmel., Syst. Nat., I, 153, 1788.

Pteromys hudsonius Fischer, Synop., 365, 1825. — Baird, Mam. N. Am., 288, 1857.

Pteromys sabrinus Rich., Zool. Journ., III, 519, 1828.

Pteromys alpinus Wagner, Suppl. Schreber's Säugt., III, 230, 1843.

Pteromys oregonensis Bachm., Journ. Acad. Nat. Sci. Phila., VII, 101, 1839.

Hab. Northern North America, north of about the isotherm of 40° F.

Genus TAMIAS.

7. Tamias striatus.

Sciurus striatus Linn., Mus. Adolphi Fred. Regis., I, 8, 1754.

Tamias striatus Baird, 11th Rep. Smith. Inst., 55, 1857. — Ibid., Mam. N. Am., 272, 1857.

"*Tamias americanus* Kuhl, Beitr. zur Zool., 69, 1820."

Sciurus (*Tamias*) *Lysteri* Rich., Faun. Bor. Am., I, 181, 1829.

Hab. Northern Maine to Virginia on the Atlantic Coast; in the interior north to the northern shores of Lakes Superior and Huron; west to the Missouri River.

8. Tamias quadrivitatus.

a. var. quadrivitatus.

Sciurus quadrivitatus Say, Long's Exped., II, 45, 1823.

Hab. Rocky Mountains, and westward in the mountain ranges to the Pacific Coast.

b. var. pallidus.[1]

Tamias quadrivitatus Baird, Mam. N. Am., 297, 1857 (in part only).

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[1] The small, pale form of the high, dry plains of the interior.

Hab. The Great Plains, and the desert region generally of the interior of the continent.

c. var. **Pallasi.**

Sciurus striatus (in part only) of the older authors.
Tamias Pallasi Baird, 11th Rep. Smith. Inst., 55, 1857.

Hab. Northeastern Asia; northern North America, west of Lake Winnipeg, south to United States; not west of the main chain of the Rocky Mountains.

d. var. **Townsendi.**

Tamias Townsendi Bachm., Journ. Phil. Acad. Nat. Sci., VIII, 68, 1839. — Baird, Mam. N. Am., 300, 1857.
Tamias Hindei Gray, Ann. and Mag. Nat. Hist., x, 264, 1842.
Tamias Cooperi Baird, Proc. Acad. Nat. Sci. Phila., VII, 334, 1855.
Tamias quadrimaculatus Gray, Ann. and Mag. Nat. Hist., 3d Ser., XX, 435, 1867.

Hab. Pacific Coast, from Northern California north to Sitka? and east to the Cascade Range.

e. var. **dorsalis.**

Tamias dorsalis Baird, Proc. Acad. Nat. Sci. Phila., VII, 332, 1855. — Ibid., Mam. N. Am., 300, 1857.

Hab. Arizona; Utah.

9. **Tamias lateralis.**

Sciurus lateralis Say, Long's Exped. R. Mts., II, 46, 1823.
Spermophilus lateralis Baird, Mam. N. Am., 312, 1857.

Hab. Rocky Mountains, from New Mexico northward (to latitude 57°, according to Richardson).

Genus SPERMOPHILUS.

10. **Spermophilus Harrisi.**

Spermophilus Harrisi Aud. and Bach., Quad. N. Am., III, 267, 1854. — Baird, Mam. N. Am., 313, 1857.

Hab. The Great Interior Basin (Utah, Nevada, Arizona?) and Lower California.

11. Spermophilus Franklini.

Arctomys Franklini Sabine, Linn. Trans., XIII, 587, 1822.
Spermophilus Franklini Baird, Mam. N. Am., 314, 1857.

Hab. Northern Illinois northward to the Saskatchewan.

12. Spermophilus tereticaudus.

Spermophilus tereticaudus Baird, Mam. N. Am., 315, 1857.

Hab. Fort Yuma, California.

13. Spermophilus tridecem-lineatus.

a. var. tridecem-lineatus.

Sciurus tridecem-lineatus Mitchell, Med. Repos., XXI, 248, 1821.
Spermophilus tridecem-lineatus Baird, Mam. N. Am., 316, 1857 (in part only).
Arctomys Hoodii Sabine, Linn. Trans., XXI, 590, 1822.

Hab. The prairies of the United States, from Arkansas northward to the Saskatchewan.

b. var. pallidus.

Spermophilus tridecem-lineatus Baird, Mam. N. Am., 316, 1857 (in part only).

Hab. The dry plains and deserts of the interior westward to the Great Basin.

14. Spermophilus mexicanus.

Sciurus mexicanus Erxleben, Syst. Anim., 428, 1777.
Spermophilus mexicanus Baird, Mam. N. Am., 319, 1857.

Hab. Southwestern Texas and Southern New Mexico, southeastward into Mexico.

15. Spermophilus spilosoma.

a. var. spilosoma.

Spermophilus spilosoma Bennett, Proc. Zool. Soc. Lond., I, 40, 1835. —Baird, Mam. N. Am., 321. 1857.

Hab. Western New Mexico west to the Pacific Coast.

b. var. obsoletus.

Spermophilus obsoletus Kennicott, Proc. Acad. Nat. Sci. Phila., 1863, 157.

Hab. Eastern base of the Rocky Mountains north to Western Wyoming.

16. Spermophilus Parryi.

a. var. Parryi.

Arctomys Parryi Rich., Parry's Second Voyage, App., 316, 1825.
Spermophilus Parryi Baird, Mam. N. Am., 323, 1857.

Hab. Northern parts of the continent, from Hudson's Bay to Behring's Straits; also on the islands of the Asiatic side of the Strait.

b. var. kodiacensis.[1]

Hab. Island of Kodiac.

c. var. erythrogluteia.

Arctomys Parryi var. *β. erythrogluteia* Rich., Faun. Bor. Am., I, 161, 1829.

Hab. Northwestern America south to Puget Sound.

? d. var. phœnognatha.

Arctomys Parryi var. *γ. phœnognatha* Rich., Faun. Bor. Am., I, 161, 1829.

Hab. Shores of Hudson's Bay.

17. Spermophilus Richardsoni.

a. var. Richardsoni.

Arctomys Richardsoni Sabine, Trans. Linn. Soc., XIII, 589, 1822.
Spermophilus Richardsoni Baird, Mam. N. Amer., 325, 1857.

Hab. Plains of the Saskatchewan southward to the Upper Missouri, and west to the Rocky Mountains.

b. var. elegans.

Spermophilus elegans and *armatus* Kennicott, Proc. Acad. Nat. Sci. Phila., 158, 1863.

Hab. From eastern base of Rocky Mountains to a little west of Fort Bridger.

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[1] A form with cinerous lower parts, less fulvous above, and more bushy tail, from the Island of Kodiac.

18. Spermophilus Townsendi.

a. var. Townsendi.

Spermophilus Townsendi Bach., Journ. Acad. Nat. Sci. Phila., VIII, 611, 1839.

Hab. Plains of the Columbia.

b. var. mollis.

Spermophilus mollis Kennicott, Proc. Acad. Nat. Sci. Phila., 1863, 157.

Hab. Northern Rocky Mountains, from about lat. 45° north into the British Possessions.

19. Spermophilus grammurus.

a. var. grammurus.

Sciurus grammurus Say, Long's Exped. R. Mts., II, 72, 1823.

Spermophilus grammurus Baird, Mam. N. Am., 310, 1857.

Spermophilus Couchii Baird, Proc. Acad. Nat. Sci. Phila., VII, 332, 1855.—Ibid., Mam. N. Am., 311, 1857. (Black form from Texas.)

Spermophilus Buckleyi Slack, Proc. Acad. Nat. Sci. Phila., VIII, 314, 1861. (Melanistic form from Western Texas.)

Hab. Western Texas and New Mexico west to Sierra Nevada Mts.

b. var. Beecheyi.

Arctomys (*Spermophilus*) *Beecheyi* Rich., Faun. Bor. Am., I, 170, 1829.

Spermophilus Beecheyi Baird, Mam. N. Am., 307, 1857.

? *Spermophilus macrourus* Bennett, Proc. Zool. Soc. Lond., I, 41, 1833. (Melanistic.)

Hab. West of Sierra Nevada Mts. from northern California south to Lower California.

c. var. Douglassi.

Arctomys ? (*Spermophilus ?*) *Douglassi* Rich., Faun. Bor. Am., I, 172, 1829.

Spermophilus Douglassi Baird, Mam. N. Am., 309, 1857.

Hab. Pacific Coast from Northern California to Puget's Sound.

20. Spermophilus annulatus.

Spermophilus annulatus Aud. and Bach., Jour. Acad. Nat. Sci. Phila., VIII, 319, 1842.

Hab. Plains of Colima, Mexico.

21. Cynomys ludovicianus.

"*Arctomys ludovicianus* Ord, Guthrie's Geog. (2d Am. Ed.), II, 292, 303, 1815."

Cynomys ludovicianus Baird, Mam. N. Amer., 331, 1857.

Cynomys socialis and *grisea* Raf., Am. Month. Mag., II, 45, 1817.

Arctomys missouriensis Warden, Descrip. U. S., V, 627, 1820.

Arctomys latrans Harlan, Faun. Am., 306, 1825.

Hab. The great plains east of the Rocky Mountains, from southern Texas nearly to the British Boundary.

22. Cynomys columbianus.

"*Arctomys columbianus* Ord, Guthrie's Geog. (2d Am. Ed.), II, 292, 302, 1815."

Anisonyx brachyura Raf., Am. Month. Mag., II, 45, 1817.

Arctomys Lewisi Aud. and Bach., Quad. N. Am., III, 32, 1853.

Cynomys Gunnisoni Baird, Proc. Acad. Nat. Sci. Phila., VII, 334, 1855.—Ibid., Mam. N. Am., 335, 1857.

Hab. The parks and plains within and west of the Rocky Mountains to the plains of the Columbia.

23. Arctomys monax.

Arctomys monax Linn., Syst. Nat. (10th ed.), I, 601, 1758.—Baird, Mam. N. Am., 339, 1857.

Arctomys empetra Schreber, Säugt., IV, 143, 1774.

Arctomys pruinosus Gmelin, Syst. Nat., I, 144, 1788.

"*Arctomys melanops* Kuhl, Beitr., 64, 1820."

Hab. Eastern North America, from Hudson's Bay to Virginia, and west to the Missouri River.

24. Arctomys caligatus.

Arctomys caligatus Eschscholtz, Zool. Atlas, II, 1, 1829.

Arctomys pruinosus Richardson, Zool. Journ., III, 518, 1828 (nec Gmelin). (In part only.)

Arctomys okanaganus King, Narr. Back's Journ., II, 257, 1836.

Hab. Puget's Sound northward, west of the Rocky Mountains.

25. Arctomys flaviventer.

Arctomys flaviventer Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 99, 1841.—Baird, Mam. N. Amer. 343, 1857.

Hab. Rocky Mountains, west to the Pacific Coast.

Prof. C. H. Hitchcock gave an account of the Helderberg Rocks of New Hampshire. From the discovery of characteristic fossils, especially a Pentamerus, perhaps the *P. Knightii*, these rocks seem to belong to the lower Helderberg series. Prof. Hitchcock, with the aid of map and diagrams, described in detail the geology of the northern portion of Grafton Co., N. H., in which the Helderberg rocks occupy three areas in the neighborhood of Littleton, North Lisbon, and Lyman.

Mr. S. H. Scudder exhibited a large series of drawings of Georgian Insects, principally of the transformations of Lepidoptera, executed by Abbot more than fifty years ago.

One collection was painted for Dr. Oemler, of South Carolina, and has recently been purchased by friends for the Society; it consists of nearly two hundred colored drawings of Lepidoptera, very few of which are given in the work of Sir James Edward Smith. Another collection formerly belonged to Mr. Raddon, of England, and was afterwards given to Dr. Asa Gray, who has identified the plants figured, and has now transferred it to the Society's library; it is composed of about the same number of sheets, mainly representing the transformations of Lepidoptera, nearly all distinct from those in the first series, or those published by Smith. Mr. Scudder added a brief account of other similar collections, especially of those in the British Museum, and gave a short sketch of Abbot's life.

The thanks of the Society were voted to Dr. Gray for his very valuable gift.

The amendments to the By-Laws, proposed at the last meeting, were then discussed, and the question being put to vote, the following amendments were adopted: —

That the following Section be added to the By-Laws: —

"SECTION II. OF THE ELECTION OF OFFICERS.

"*Article* 1. Whenever any existing or anticipated vacancy in the list of officers is to be filled by election, a Nominating Committee shall be appointed by the Society at a stated meeting, to bring in at a subsequent meeting one or more nominations of persons to fill each such vacancy; but additional nominations may also be made in any other way.

"*Article* 2. No person shall be elected to any office until his nomination has been under consideration by the Society for at least two weeks."

And, in consequence, that SECTIONS II to X of the By-Laws become SECTIONS III to XI, respectively.

SECTION II. *Articles* 7 and 8.

That the words 'Committees on Departments of the Museum' be substituted for the word 'Committees,' where this word occurs for the first time in each of these Articles.

SECTION V. *Article* 2.

That the word 'of' be changed to 'on' after the word 'Committee.'

SECTION VI. *Article* 1.

For the words 'Committee on Publications,' read 'Publishing Committee.'

February 18, 1874.

The President in the chair. Fifty-seven persons present.

The following papers were read: —

ON AMBER IN NORTH AMERICA. BY DR. H. A. HAGEN.

It may, perhaps, not be inopportune to draw the attention of American geologists to an American paper published fifty years ago, and treating of an interesting geological fact in a very interesting manner, and nevertheless almost entirely overlooked since, at least by all foreign naturalists.

Dr. G. Troost, of Baltimore, Md., published in the third volume of Silliman's American Journal of Science in 1821, a paper entitled, "Description of a variety of amber, and of a fossil substance supposed to be the nest of an insect, discovered at Cape Sable, Magothy River, Ann Arundel Co., Maryland."

The title of the paper may have its share in its oblivion, because the paper contains much more than is indicated by it, and gives an elaborate account of the geological formation at Cape Sable, of the successive situation and thickness of the strata, and a scientific determination of their mineralogical contents. All statements of the author concerning European amber, proving a perfect acquaintance with the matter, are well founded, and, considering the time of publication, are rather remarkable.

Fifty years ago the geological strata containing the fossil called amber (Bernstein), and still more, all the strata connected with it, were hardly studied. Born in the country where most of the amber known has been found for centuries, and initiated in the study of the subject by my grandfather and my father, both authors of valuable papers about amber, I have myself studied this curious fossil and the palæontological remains very often admirably preserved in it. By mere accident I became aware of the existence of Dr. Troost's paper, entirely unknown to European naturalists, and of course overlooked in every bibliography concerning amber.

Two valuable scientific periodicals [1] had published short extracts of the quoted paper; nevertheless, at the time, these extracts were overlooked, for these periodicals rarely contained geological matter. As the paper of Dr. Troost seemed to be exceedingly interesting, I presented a translation to the Physico-Oeconomical Society of Koenigsberg, Prussia, now for years the centre of all works and studies concerning the amber of Europe. This translation was published in the Society's Memoirs, 1871, Vol. XI, with a learned and interesting report from its most competent member, Dr. G. Berendt, which report, together with somewhat more detailed written remarks by the same geologist, induced me chiefly to present this communication.

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[1] Schweigger Jahrbuch der Chemie u. Physik, 1822, p. 434. Karsten Archiv, Vol. VI, p. 416.

The geological profile of Cape Sable in Maryland, according to Dr. Troost, is formed as follows:—

15–70	feet thick.	Sand, the lower part with a coarse ferruginous sandstone.
		Mixture of lignite and sand with amber.
3½–4	“	Lignite.
15–20	“	Sand with large nests of pyrites, or instead, of shaly clay.
5–12	“	Earthy lignite with pyriteous wood, and large fragments of bituminous trees; with streaks and nests of gray clay, pebbles of greasy quartz and insect nests of earthy amber.
2–5	“	Argillaceous sandstone, with small masses of pyrites.
4	“	Whitish gray clay, exempt from pyrites.
		White sand, in which the water is so abundant as to render it difficult to penetrate lower.

Comparing this profile with the profile of the coast of Samland, in Eastern Prussia, there is no resemblance to be found except in the occurrence of amber in sandy strata, and the agglutinations of the sand by iron oxide (or iron oxide hydrate), similar to the so-called krantlayers in Eastern Prussia. Whether the sand has any similarity to the glauconite (*Grün Sand*) of the amber strata in Prussia, is still entirely unknown; the agglutination being only a secondary process, to be found in sands of the most different formations.

A striking difference between the amber strata in Eastern Prussia, and those in Maryland, is the occurrence of the lignite only below the amber strata in Maryland, only above the amber strata in Eastern Prussia. This difference, and the immediate neighborhood of amber and lignite, would perhaps indicate the occurrence of amber in Maryland as homologous with the occurrence of amber in the so-called striped sand belonging to the lignite layers of Eastern Prussia. This supposition is supported by the fact quoted in the first note at the end of Dr. Troost's paper, which runs as follows:—

"According to Hotsman, who has examined the Prussian mines, the amber seems not to be in contact with the pyrites, but the mines are worked in a bed of coarse sand below." Mr. Hotsman, by the way, a person entirely unknown in Prussia, seems to have visited the mines worked twenty-four years at the end of the last century, near Great Hubnicken. These mines were undoubtedly situated in lignite strata, and only those strata could have been chosen for a comparison with the Maryland strata, and not at all those later discovered in a greater depth in the so-called blue earth, which is always below and never above the coarse sand.

I am sorry that there is not a piece of Maryland amber at hand. But the determination by Dr. Troost is to be accepted as correct, because the remarks of the author prove his acquaintance with this fossil, the more so as retinasphalt from the Magothy River, at Cape Sable, was chemically analyzed by him, and the analysis published. (*c. f.* Gmelin Handb. Chemie, 1866, p. 1836.)

A scientific opinion concerning the relation of the amber strata in Maryland, and the stratum of the blue earth in Eastern Prussia, is still impossible, and necessarily depends on a careful and more exhaustive examination of the American locality. It seems evident that the strata, twenty to twenty-five feet thick, at Cape Sable, belong to tertiary lignite-bearing strata, a fact corroborated by later published geological maps, giving the geological formation of Maryland as eocene and miocene, analogous to the geological formation of the Samland coast in Eastern Prussia. Even the first stratum of Dr. Troost, the fifteen to sixty or seventy feet sand above the amber stratum, is apparently not to be separated from the lignite stratum. The word alluvium, used in the beginning of the paper, designates only what Werner calls *aufgeschwemmte Gebirge* — alluvial mountains — and not the terms alluvium and diluvium used at present as counterpart of the tertiary rocks.

As the only rich bed of amber in tertiary layers now known is that on the coast of Samland in Eastern Prussia, a more thorough examination of the locality of Cape Sable would afford perhaps a great interest for science and commerce. For practical purposes it would be important to ascertain whether the bed of amber is sufficiently rich to be worked, or whether the pyrites could not be used with profit for the manufacture of sulphuric acid.

With regard to the scientific question, it would be necessary to form a complete collection of samples of the different strata. A careful comparison of these samples with the Prussian strata would afford a great deal of interest. In this connection the following questions would be of prominent importance.

American scientific literature, so far as I know, affords very little concerning amber found in America. The Geology of New Jersey by George H. Cook, State Geologist (Newark, 1868, p. 283), says, amber is found irregularly distributed in all parts of the marl region. Specimens have been seen from marl pits in every county of the region, but there is no certainty of finding other specimens in the same localities. Pieces enough to have filled a barrel are said to have been taken from one marl pit at Shark River, about twelve years ago, but since that, in looking over many hundred tons of marl there, not a fragment was found. The mineral is yellow in color, but is not so compact or lustrous as good specimens of foreign amber.

Dana's Mineralogy mentions amber, and Appleton's American Geologist, Vol. I, p. 445, gives as localities, Amboy, N. J., Gayhead, Martha's Vineyard, Mass., and Cape Sable, Md.

Mr. H. D. Rogers, in his Description of the Geology of the State of New Jersey, Philadelphia, 1840, mentions twice, pp. 180, 185, the occurrence of amber. There is also a mention of American amber in Silliman's Amer. Journ., X, 171; XVII, 292. For these few data I am indebted to Mr. W. Holden, of Marietta, Ohio.

Almost all my attempts to see pieces of amber found in America have been unsuccessful. The University collections in Cambridge and New Haven do not possess specimens. According to a communication from Mr. Ph. R. Uhler, in Baltimore, amber is found in Maryland, about twenty-five miles from Baltimore, in a lignite bed, but in very small quantities, and he did not succeed in finding any one possessing specimens. Through his kindness I obtained a small piece from Pennsylvania, which, however, was declared not to be amber at all, by the most experienced authorities in Prussia.

Later I was favored by Dr. Endlich, from Reading, Pennsylvania, with two small pieces of true amber. But as no locality was given, and as the pieces formerly belonged to an apothecary, who professionally used to keep some amber in store, I can not consider these pieces as of undoubted American origin.

The discovery of amber in larger quantities in America would be of the greatest interest. It would certainly contain here, as in Europe, fossil remains, and promote the knowledge of the fossil fauna and flora in a remarkable manner. The so-called insect nest and the doubtful fruit mentioned by Dr. Troost, seem to prove that these strata are not without palæontological remains. It may not be well known to American students, (as the amber formation is a very local one, and rich only in eastern Prussia), that the flora and fauna included in the amber itself, or in the strata just above, have a decided North American character. Professor Göppert, of Breslau, the eminent botanist, goes even so far as to identify some of the amber plants with some living ones in North America. I should add, that his opinion is not shared by other German naturalists, and is even positively contradicted for some species. Nevertheless, the similarity is rather striking. The amber fauna, mostly consisting of articulata, gives an analogous result. A fossil amber-genus of white ants, *Termopsis* of Professor Heer, is represented by a single living species in North America; and of a very remarkable *Psocid*, also found in amber, *Amphientomum*, a species was discovered not long ago by Dr. A. S. Packard, Jr., in New England.

It would be out of place to dwell more on these analogies here, though many other facts are at hand. It may be that amber, which also occurs in Greenland, will be discovered in the southern and western parts of the United States. When I first saw the shores of the Lakes Huron and Michigan, and the Island of Mackinaw, I was so struck by their resemblance to the shores of my native country, the very locality where amber is found, that I could not help thinking that here also amber would be discovered.

I conclude by recommending to American geologists this interesting geological question. The accidental circumstance of my birth in the, as yet, richest amber country, convinced me of the advantages which geologists may derive from a careful study of this singular mineral.

Dr. Chas. Pickering remarked that in 1826 specimens of amber, claimed to have been brought from the region of the Chesapeake and Delaware Bays, were plenty in Philadelphia.

Dr. Sterry Hunt observed that the glauconite or greensand marl of New Jersey, and along our eastern coasts, is generally of cretaceous age, as in Europe; although glauconite is by no means confined to that horizon, since he had analyzed and described glauconites of Cambrian age, viz.: from the Potsdam of the Mississippi Valley, and from the

Levis formation near Quebec. In Finland also these ancient glauconites are found, while from Vermont he had examined a glauconite of later tertiary age. Dr. Hunt had also received from the late Dr. Torrey a kind of fossil resin from the marl-pits of New Jersey, which had not yet been studied. He referred farther to the well-known frequent occurrence of a resin-like substance in the more recent coals and lignites of the west, and said Dr. Newberry had observed a similar matter in the paleozoic coal of Perry Co., Ohio. These bodies are perhaps none of them identical with amber, but so nearly related to it as to be of interest in this connection. Dr. Hunt had also described a hard infusible resin in the plant-bearing Devonian sandstones of Gaspé, on the Gulf of St. Lawrence, found cementing together grains of coarse sand, and constituting about one-half the weight of the rock. It resembles amber, but is perhaps more nearly related to the substances named scleretinite and middletonite.

THE DEPOSITION OF CLAYS. BY DR. T. STERRY HUNT.

It is known to chemists that many bodies insoluble in water, when in a finely divided state, remain for a long time in suspension in that liquid, and readily pass with it through the pores of paper filters; but that the addition to the water of a small portion of acid or saline matter prevents this passage, and, moreover, causes the suspended matters to subside rapidly, leaving the liquid clear. This tendency, which shows itself in many uncrystalline substances, such as, for example, hydrated titanic and stannic acids, and a certain modification of hydrated ferric oxyd, is also very noticeable in clays. It is a well known fact that clayey waters will remain turbid for days, but may be readily rendered clear by the addition of a little salt or alum, which soon causes the clay to settle. The turbidity of such a water is, in fact, a mark of the purity or freedom from soluble salts. Prof. E. W. Hilgard has lately applied this property to the mechanical analysis of soils, separating the clay from the sand by suspension in pure water, and afterwards precipitating it by the addition of common salt. He employed for this purpose one and a half parts of salt to one hundred of water, but found that the half of this quantity, or even less, would suffice to cause the ready precipitation of the clay from the water.

The first notice of the geological significance of this fact occurs, so far as I am aware, in the Report of Messrs. Humphreys and Abbot on the Physics and Hydraulics of the Mississippi, published in 1861, where, in the Appendix A, page XI., Mr. Sidell, having examined the turbid waters of the river near its mouth, found it to contain about one two-thousandth of suspended matter, chiefly clay, which required from ten to fourteen days to subside. He, however, observed that the addition to it of a portion of sea-water, or of common salt, alum, sulphate of magnesia or sulphuric acid, sufficed to render the turbid water clear in from twelve to eighteen hours. He thus explained the ready precipitation of the suspended clay when these turbid waters come in contact with the salt waters of the Gulf, causing great deposits of fine mud, and helping us to understand the origin of the accumulations of argillites and clay slates which are met with in various geological formations. This action of salt water has lately been insisted upon by an English author, who is apparently not aware of the observations and conclusions of Mr. Sidell. The latter, who does not appear to have followed farther this curious phenomenon suggests that it may be explained by some action of the salts upon a portion of dissolved organic matter, the coagulation of which may precipitate the suspended clay; but experiments show that it is independent of the presence of organic substances.

An explanation is, however, I think to be found in the researches of Guthrie on the formation of Drops, published in the Proceedings of the Royal Society for 1864 (Vol. XIV). In studying the size of drops of water falling from a small sphere of ivory, he found that the cohesion of the water was diminished when it held saline matters in solution, as was shown by the smaller size of the drops. This was verified by experiments with solutions of various strengths of nitre and of chlorid of calcium. It was found that the addition of eight parts of the latter salt to one thousand of water, reduced by one-ninth the size of the drops, as determined by their lessened weight. These results show a diminished cohesion of the liquid to the ivory sphere, from which it was by the force of gravity made to fall. The cohesion, in virtue of which the extremely attenuated particles of clay are held suspended in water in opposition to gravity, is, in like manner, so far reduced by the addition to the water of a portion of saline matter, that gravity and cohesion rapidly assert themselves among the suspended particles, which come together and soon subside, leaving the saline liquid clear. The precipitation of suspended clays is very rapid when a strong solution of salt is made use of.

THE LOWER WABASH VALLEY, CONSIDERED IN ITS RELATION TO THE FAUNAL DISTRICTS OF THE EASTERN REGION OF NORTH AMERICA; WITH A SYNOPSIS OF ITS AVIAN FAUNA.

BY ROBERT RIDGWAY.

PART I. — *General Preliminary; Relation of the Lower Wabash Valley to the Faunal Districts of the Eastern Region of North America; local characteristics of its Avian Fauna.*

The present paper is intended as a step toward supplying an important deficiency in our knowledge of the geographical distribution of the birds of the Mississippi Valley. In this undertaking encouragement is given by the success of Mr. Allen's treatment of the avifauna of adjoining portions,[1] as well as by the hope that a gap existing between the local lists of the Atlantic States and those States along the western border of the Mississippi may be filled.

It is the purpose to here present a condensed review of the birds belonging to a section of the country which is of great interest to ornithologists, from the fact that it is as yet comparatively a *terra incognita* as regards our knowledge of the details of its bird life. No portion of the Eastern Region of North America presents a richer field for ornithological research. This arises from its unusually favorable physical conditions and consequent diversity of natural productions, for no portion of the continent is more replete with both animal and vegetable life. The wild regions of the Far West have been almost exhausted of novelties in this line through the agency of numerous Government Surveys which have traversed them in every direction, while the States bordering the Atlantic have been pretty thoroughly worked up by the zealous efforts of various local naturalists; but the long-settled and easily-accessible district here treated, has, to the present day, been neglected.

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[1] The titles of Mr. Allen's papers on the birds of localities in the Mississippi Valley, are the following: —

I. Notes on the Birds observed in Western Iowa (July 1 to Sept. 20 — 108 species), Northern Illinois (June — 94 species) and Richmond, Wayne Co., Indiana (June — 72 species). Mem. Bost. Soc. Nat. Hist., Vol. I, pp. 491 — 526.

II. List of Birds observed in Leavenworth, Kansas, from May 2 to May 11, and at Topeka, Kansas, from May 11 to May 24, 1871; with annotations. Bulletin of the Mus. Comp. Zool., Cambridge, Mass., Vol. III, No. 6, July, 1872, pp. 122-131. (121 species.)

In his valuable work on the geographical distribution of North American birds[1] Mr. Allen notes in the following words the lack of information in regard to the avifauna of the region of which the lower Wabash Valley is a part:—"The data are tolerably full only for the region embraced between the St. Lawrence and the Upper Lakes on the north, and the Ohio River and Virginia on the south. Much is also known, however, in regard to the other Atlantic States; *but in respect to the whole region of the lower Mississippi and the Gulf States, the recorded facts bearing upon this subject are lamentably few.* The importance of complete and carefully annotated lists of the birds of many localities in the South Atlantic and Gulf States, *and in the Mississippi Valley,* is hence clearly manifest" (p. 391, italics are ours.) Although the lower Wabash Valley does not apparently come within the region indicated above in a geographical sense, yet it is demonstrable that it is strictly a part of it as far as its natural productions are concerned.

The field of this paper comprises the area drained by the Wabash River and its tributaries, both in Illinois and in Indiana, as far north as Vincennes, and lies between parallels 38° and 39° North latitude. The greater part of the investigations upon which it is based have, however, been made in the vicinity of Mt. Carmel (Wabash County) and Olney (Richland County) in Illinois, and on the Indiana side of the Wabash River directly opposite the former locality. Occasional excursions to the southward not having revealed the slightest difference in the avifauna from that of the three points mentioned, it is presumed that its character is quite homogeneous throughout the whole extent of the district named. In fact, though the distance from the Ohio River to the nearest point on the Gulf of Mexico is fully six hundred miles, no very marked change can be noticed in either the fauna or flora in proceeding southward along the Mississippi, until the alligator (*A. mississippiensis*), long moss (*Tillandsia usneoides*), evergreen magnolia (*M. grandiflora*), live oak (*Quercus virens*) and fan-palm (*Chamærops*) are first found, at a certain latitude (somewhere near the parallel of 33°), which marks the northern limit of the sub-tropical belt of the Gulf coast. Of course the characteristic southern species gradually become more abundant to the southward, but nearly all extend northward well into the Wabash Valley.

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[1] Bulletin of the Museum of Comparative Zoology, Cambridge, Mass., Vol. II, No. 3, pp. 375–425, 1870.

The vegetation of the lower Wabash Valley if not essentially southern has a very decided impress of the southern character, the subtropical forms mentioned above being the main desiderata. Among the forest trees the pecan (*Carya olivæformis*) extends up the Wabash as far as Terre Haute; the bald cypress (*Taxodium distichum*) forms a swamp in Knox Co., Indiana, covering seventeen thousand acres;[1] the catalpa (*C. bignonioides*) is a common underwood throughout the bottom-lands south of Vincennes; while the tupelo gum (*Nyssa uniflora*), water locust (*Gleditschia monosperma*), southern hackberry (*Celtis mississippiensis*) and lyre-leafed oak (*Quercus lyrata*) are more or less abundant in the woods. The tropical family *Bignoniaceæ* has four representatives, viz., *Catalpa bignonioides, Bignonia capreolata, Tecoma radicans* and *Martynia proboscidea* — all abundant — only one other species (*Tecoma stans*, found in Florida) occurring in the United States. Besides these southern plants, the *Cocculus carolinus*, several southern species of *Smilax* and *Cuscuta*, the *Hibiscus grandiflorus*, *Cabomba caroliniana*, *Nelumbium luteum* (growing in great abundance and magnificence) and a host of other strictly southern species attest the decidedly southern nature of vegetation of the lower Wabash.[2] Among the southern reptiles the following species have been found near Mt. Carmel:[3] *Ancistrodon piscivorus* (the dreaded "cotton-mouth" or moccasin of southern plantations), *Eutænia faireyi, E. dorsalis, E. proxima, Tropidonotus erythrogaster, T. transversus, Heterodon cognatus, Coluber confinis,*

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[1] Wabash County, Illinois, contains 128,420 acres; 69,853, or more than one-half of this area is woodland, most of which is primitive forest. (County assessment of 1873.)

[2] In this connection the reader is referred to the following papers by the writer, published in the *American Naturalist*: — Notes on the Vegetation of the lower Wabash Valley. — I. The Forests of the Bottom Lands, Vol. VI, Nov., 1872.— II. Peculiar Features of the Bottom Lands, Vol. VI, Dec., 1872. — III. The Woods and Prairies of the Upland Portions, Vol. VII, March, 1873.

[3] In giving the above list of Ophidians, I must acknowledge the valuable assistance rendered me in this line by my friend Mr. Lucien M. Turner, of Mt. Carmel, who has collected many of the species named, and has them in his possession. The doubtful of these have been determined by Professor Cope, so that their identification is authentic. My authorities for the other species are Mr. Kennicott's list in the first volume of the Illinois Agricultural Report (1853, pp. 591–593), and the invoice sheets and specimens in the Smithsonian Collection. The total number of species of serpents known with certainty to be found in Illinois, is about 45; this number no doubt will be increased to considerably more than fifty species.

Ophibolus sayi, *Osceola elapsoidea*, *Abastor erythrogrammus* and *Cychlophis æstivus*. In addition to these, other collectors, chiefly Mr. Kennicott, have obtained the following species in different portions of Southern Illinois:— *Tropidonotus woodhousi*, *Regina grahami*, *Ophibolus doliatus*, *O. evansi*, *Diadophis arnyi*, *Haldea striatula*, *Farancia abacurus*, *Virginia valeria*, *V. elegans*, *Celuta helenæ* and *C. vermis*. Of the seven species of lizard which are known to be inhabitants of Illinois, four of them (*Ophisaurus lineatus*, *O. ventralis*, *Lygosoma laterale* and *Ameiva sex-lineata*) are chiefly southern. Among the mammals the southern *Vulpes virginianus* and *Lynx rufus* largely preponderate over, if they do not replace, the northern *V. fulvus* and *L. canadensis*. There also occur *Neotoma floridana*, *Hesperomys aureola*, *H.* (*Oryzomys*) *palustris*, and *Reithrodon humilis* — all emphatically southern species.

The avian-fauna of this section is as quite decidedly southern as the reptilian-fauna and the flora. Mr. Allen considers twenty-four species of birds as peculiar to the "Louisianian Fauna." Of this number only ten remain to be discovered in Southern Illinois. Few of these ten species have been found so far as one hundred miles away from the coast, since their distribution is governed by other conditions than those of climate. They are mostly pelagic or littoral species, which of course never go inland, and tropical land-birds which in the United States are confined to the hot Gulf-coast. The species are the following: — *Puffinus obscurus* (strictly pelagic); *Platalea ajaja*, *Ibis alba*, *Demiegretta ludoviciana*, *Chamæpelia passerina*, *Quiscalus major*, *Picus borealis*, *Sitta pusilla*, *Helinaia swainsoni* (known only from Georgia and Florida) and *Helminthophaga bachmanni* (known only from lower South Carolina and Cuba). Of these, *Ibis alba* and *Demiegretta ludoviciana* will probably yet be found in Southern Illinois, since they have been traced quite as far to the northward both on the Atlantic coast and west of the Mississippi. *Platalea ajaja* may possibly occur, since *Plotus anhinga* and *Tantalus loculator*, equally characteristic of the Tropics, are quite common. *Picus borealis* and *Sitta pusilla* are without doubt yet to be found among the yellow pines (*Pinus mitis*) and red cedars (*Juniperus virginianus*) which grow abundantly in many localities south of Wabash County. *Quiscalus major* and *Chamæpelia passerina* are hardly to be looked for, for evident reasons. The remaining fourteen have already been detected, the following being the species: *Peucæa æstivalis* (common, breeding; known before only from Georgia and adjoining portions of Florida and South Carolina); *Cyanospiza ciris* (one specimen); *Protonotaria citrea* (a very abundant and characteristic summer bird in the bottom-lands); *Dendroica dominica* (not rare, breeding); *Antrostomus carolinensis* (not rare, breeding?); *Campephilus principalis* (rare — but probably as numerous as it is anywhere, and breeding); *Conurus carolinensis* (formerly excessively abundant, but now exceedingly rare, except in certain bottom-lands, and breeding); *Catharista atrata* (occasional); *Ictinia mississippiensis* (very abundant on the prairies, and breeding); *Nauclerus forficatus* (excessively abundant on the prairies, and breeding); *Elanus leucurus* (one pair noticed in summer at a lagoon in the bottom-lands); *Tantalus loculator* (quite common, — breeding?); *Plotus anhinga* (rare as far north as Mt. Carmel, but common towards the Ohio, — breeding?); *Porzana jamaicensis* (not rare, breeding); and *Graculus dilophus* var. *floridanus*. Besides these, the writer has also found the *Asturina nitida* (var. *plagiata*), a hawk of tropical America not previously found within the United States (see "American Naturalist," Vol. VI, July, 1872, p. 430), though it was obtained by Lieut. Couch on the Mexican side of the Rio Grande, and has since been found breeding in Arizona, by Capt. Bendire.

The great mass of the birds, however, are mainly those characteristic of the "Carolinian Fauna," as defined by Mr. Allen (pp. 394, 395), all of these being abundant, with the exception of some species belonging to the littoral and pelagic series,[1] which, of course, are not found at all. The following species of this fauna are permanent residents in the lower Wabash Valley, and are as abundant in winter as in summer: —*Cardinalis virginianus*, *Thryothorus ludovicianus*, *Lophophanes bicolor*, *Centurus carolinus*, *Rhinogryphus aura*, *Parus carolinensis* and *Thryomanes bewicki*. The last two species Mr. Allen omits from his list, but they are strikingly characteristic of the

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[1] What I term the *Atlantic littoral series* is a group of birds composed of four terrestrial and several aquatic species. which are never found away from the salt marshes or beaches of the Atlantic coast. These species are the following: — *Ammodromus maritimus*, *A. caudacutus*, *Passerculus princeps*, *Corvus ossifragus*, *Tringa canuta* (?), *Hæmatopus palliatus*, *Rallus crepitans*, etc. This series is represented on the Pacific coast by a corresponding one composed of *Passerculus* *Corvus caurinus*, *Aphriza virgata*, *Heterosceles brevipes* and *Hæmatopus rostratus* and *niger*. The littoral series is to be distinguished from the *pelagic series*, composed of various *Longipennes* and *Anatidæ*. The latter, like the aquatic forms of the littoral series, are more nomadic, and are apt to follow large water-courses inland, many of them being found about the Great Lakes.

Carolinian Fauna, although the latter appears to be very rare east of the Alleghanies.

The extremes of temperature in winter and summer, which are perhaps greater in the Mississippi Valley than in corresponding latitudes of the Atlantic States, no doubt explain why the northern species extend so much farther south and the southern ones so much farther north, in their respective seasons of migration, in the former region than in the latter. In short, there are more northern birds in winter and more southern ones in summer. The sedentary fauna associates in summer with one possessing a decided subtropical impress, while in winter it mingles with the arctic series. The resident *Cardinalis virginianus*, *Lophophanes bicolor*, *Parus carolinensis*, *Thryothorus ludovicianus*, *T. bewicki* and *Centurus carolinus* associate in summer with *Cyanospiza ciris*, *Guiraca cœrulea*, *Peucæa æstivalis*, *Protonotaria citrea*, *Dendroica dominica*, *Conurus carolinensis*, *Antrostomus carolinensis*, *Campephilus principalis*, and such southern forms, while their winter companions are *Ægiothus linaria*, *Loxia americana*, *L. leucoptera*, *Plectrophanes lapponicus*, *P. pictus*, *P. nivalis*, *Pinicola canadensis*, etc.; *Astur atricapillus*, *Nyctea scandiaca* and *Nyctale acadica*, may be seen in winter, where in summer *Asturina plagiata*, *Ictinia mississippiensis*, *Nauclerus forficatus*, *Elanus leucurus*, and *Strix pratincola* replace them. There is likewise an extensive overlapping of the western and eastern faunæ, since the eastward extension of the Missouri plains, in the modified form of the Illinois prairies, causes many of the western species to range as far at least as the Wabash River. The eastern species pass them and reach as far west as the Missouri River—many of them to the Rocky Mountains, or even well into that range itself.

The western element in the Illinois bird-fauna is thus rendered conspicuous by the abundance of *Chondestes grammaca*, *Collurio excubitoroides* and *Eremophila alpestris*, which breed plentifully almost everywhere; *Vireo bellii* is common, locally, even on the most eastern prairies in the State; *Sturnella neglecta* is sparingly scattered over the same area, while on those of the central and western portions *Spizella pallida* is found. *Xanthocephalus icterocephalus* is common, even abundant, in suitable sections, nearly throughout the State; *Helminthophaga celata* is abundant in the Wabash Valley during both the spring and fall migrations. *Scolecophagus cyanocephalus* is occasional in winter, while *Falco polyagrus* and *Buteo swainsoni* occur irregularly at various seasons.[1] This overlapping of the faunæ from the four points of the compass, in consequence of the central geographical location of the State, accounts for the peculiarly rich and varied nature of the Illinois Avian Fauna. .

In studying the bird-life of Southern Illinois, the ornithologist from the Atlantic States is at once impressed with many points wherein it differs from that to which he has been accustomed in the East. In summer he misses the chant of the song sparrow (*Melospiza melodia*),[2] and the merry gabbling song of the house wren (*Troglodytes œdon*); these seem to be entirely replaced by the *Chondestes grammaca*, a western species possessing an unrivalled song, and the *Thryomanes bewicki*, with a loud, clear chant similar to but much finer than that of *Melospiza*. In the meadows the "dick-sissels" (*Euspiza americana*) are abundant, the males perching upon the fence stakes as they pour forth their rude but incessant ditty; around the border of the old fields the rich musical chant of the *Peucæa æstivalis* is heard; in the groves the fine robin-like, but well-sustained, song of the vermilion tanager (*Pyranga æstiva*) delights the ear, while troops of tufted titmice (*Lophophanes bicolor*) and Carolina chickadees (*Parus carolinensis*) rove noisily through the woods. Among the shade trees of the town-parks, and along even the busiest streets, red-bellied and red-headed woodpeckers (*Centurus carolinus* and *Melanerpes erythrocephalus*) sport without fear, while the blue jays (*Cyanura cristata*) descend from the orchard into the yards to pick up scraps of food from the very doorsteps. If he leaves the town and visits the wild woods in the "bottoms," the birds are as unfamiliar as the scenery. The cerulean warbler (*Dendro-*

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[1] As might be expected from their habits of life and facilities for migration, there is but a small mixture of the western element in the Illinois reptilian-fauna. Still, *Eutœnia parietalis* occurs plentifully in the Wabash Valley, and *Bascanion flaviventris* is found in other portions of Southern Illinois. Both of these species belong to the Western Region south of 40°. There may be other western forms found in the State, of which I am not aware.

[2] In Southern Iowa, according to Mr. Trippe (Proc. Bost. Soc. Nat. Hist., Oct., 1872, p. 237), the song sparrow is "abundant in spring and fall, but not observed to breed. Shy and retiring, a complete contrast to the eastern song-sparrow." In Southern Illinois this is also the case, the species being there a winter sojourner, abundant, but very retiring, inhabiting almost solely the bushy swamps in the bottom-lands, *and unknown as a song bird*. The same are also probably its habits throughout Illinois and the adjacent districts. This is a remarkable instance of variation in habits with longitude of one geographical race, since in the Atlantic States it breeds abundantly as far south at least as the parallel of 38°, and is besides one of the most familiar of the native birds.

ica cærulea) is abundant — but secure from the reach of shot — in the tops of the tall trees; around any pond the prothonotary and yellow-throated warblers (*Protonotaria citrea* and *Dendroica dominica*) may be seen, the one flitting through the bushes, the other creeping around and hanging from the branches which bend over the water. In the dark, damp portions of the forest are heard the rich liquid notes of the Louisiana water thrush (*Seiurus ludovicianus*) and cardinal-like song of the Kentucky warbler (*Oporornis formosus*).

On the prairies,[1] Henslow's bunting (*Coturniculus henslowi*) and the shore lark (*Eremophila alpestris*) are the most characteristic birds, along with *Vireo bellii*, *Sturnella neglecta*, *Chondestes grammaca*, *Collurio excubitoroides* (the two latter also common birds in cleared districts of the wooded portions), and *Euspiza americana*; while the gracefully floating flight of swarms of swallow-tailed kites (*Nauclerus forficatus*), and the beautiful evolutions of Mississippi kites (*Ictinia mississippiensis*) form a sight to be witnessed elsewhere only on the prairies of the South-west.

In winter the birds are even more numerous than in summer, though the increase in the number of individuals is accompanied by a diminution of the species. From about one hundred and fifteen to over one hundred and fifty species remain during the winter, the number varying considerably according to the character of the season; the former number represents about the minimum of winter residents, or the number found in severe winters, and the latter the maximum of mild winters. Of course quite a large proportion of them are more or less rare; but at least fifty species are represented by a perfect host of individuals. Among the brush-heaps, in the new clearings, in the briary scrub overgrowing neglected fields, in the shrubbery along the fences, and particularly in the bushy swamps in the bottom-lands, the sparrow tribe literally swarms, the most abundant species being the *Spizella monticola*, *Melospiza melodia*, *M. lincolni*, *M. palustris*, *Zonotrichia albicollis*, *Z. leucophrys* and *Junco hyemalis*, each represented by multitudes; associated with these excessively abundant species are plentiful numbers of *Pipilo erythrophthalmus*, *Cardinalis virginianus*, *Passerella iliaca* and *Thryothorus ludovicianus*, besides a few of *Spizella pusilla*.

In the woods are troops of *Lophophanes bicolor* (the most abundant and noisy of all our birds), nearly as many of *Cyanura cristata*, an abundance of *Parus carolinensis*, *Sitta carolinensis* and *Den-*

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[1] See *American Naturalist*, Vol. VII, April, 1873.

droica coronata, a fair sprinkling of *Sitta canadensis*, and now and then a *Sayornis fuscus* and *Turdus pallasi*; while in very mild winters the *Seiurus noveboracensis* is often seen. Of woodpeckers eight species (*Picus villosus*, *P. pubescens*, *Sphyropicus varius*, *Hylotomus pileatus*, *Centurus carolinus*, *Melanerpes erythrocephalus* and *Colaptes auratus*) are abundant.

Many of the foregoing species are nearly constant inhabitants of the door-yards and orchards, even in towns, the most familiar ones being *Junco hyemalis*, *Zonotrichia leucophrys*, *Z. albicollis*, *Spizella monticola*, *Cardinalis virginianus*, *Lophophanes bicolor*, *Parus carolinensis*, *Cyanura cristata* and *Dendroica coronata*.

With few exceptions, the birds of the bottom-lands are different from those usually found in the dryer and more open districts. In summer they are very difficult to procure, owing to the fatigue and various anoyances endured in the search for them; the value of the few obtained, however, will almost surely compensate for all the trouble experienced. Going into these heavy, luxuriant woods upon a warm day in June or July, they are so perfectly silent as to appear at first entirely uninhabited. No sooner has one come to this conclusion, however, than a yellow-throated vireo (*V. flavifrons*) flits across the path, for this bird is always upon the alert for intruders, and the individual in question has heard your approach. Alighting on a prominent twig he stretches out his neck, and peers curiously at you; if satisfied, he vanishes into the maze of foliage; but if his curiosity develop into suspicion, he suddenly breaks the silence with his harsh, scolding notes, which startle from their noon-day *siesta* all the little birds in that part of the woods. It is the well-known signal of the presence of an enemy, and soon the springing of light twigs and jostling of leaves, with an occasional twitter and chirp, makes you suddenly aware that there are birds all around. Among the numerous little fellows which are now and then detected peeking slyly at you, as they hop cautiously among the branches, or flit, with as little noise as possible, through the foliage, may be distinguished two sets, one keeping near or upon the ground, the other descending from the tree-tops to the lower branches. The most conspicuous member of the former class is the Kentucky warbler (*Oporornis formosus*), while his companions are the hooded, worm-eating, prothonotary, and blue-winged yellow, warblers (*Myiodioctes mitratus*, *Helmitherus vermivorus*, *Protonotaria citrea* and *Helminthophaga pinus*), and large-billed water thrush (*Seiurus ludovicianus*).

These are the chief terrestrial species, the oven bird, or orange-crowned thrush (*Seiurus aurocapillus*) and Carolina wren (*Thryothorus ludovicianus*) being about the only ones which ever reinforce them. The arboreal series consists chiefly of "wood warblers" (*Dendroicæ*), instead of "ground warblers," (*Geothlypeæ*) and "worm-eating warblers" (*Vermivoreæ*). *D. cærulea* is by far the most common species, and with it are seen *D. dominica*, *Mniotilta varia*, *Setophaga ruticilla*, *Parula americana*, and occasionally *D. pinus*. *Lanivireo flavifrons*, *Vireosylvia olivacea*, *V. gilva*, and several *Empidonaces* (*E. acadicus*, *E. traillii*, and occasionally *E. minimus* — the former most abundant, the latter rare) about complete the list of small birds which are most likely to be observed — though the scarlet tanager (*Pyranga rubra*) may flash across an opening in the foliage, and alighting on a bare twig, sit as if intended for pure ornament, his intense scarlet plumage with velvety-black wings and tail contrasting richly with the green background of foliage. This species is mentioned the more particularly because the vermilion tanager (*P. æstiva*), so common in the dry or upland woods, is rarely, if ever, seen in the forest of the bottom-lands.

It will be noticed that in this fauna the Fringilline element is entirely wanting, but this becomes a component part as soon as an open copse or glade in the woods is reached. Then we find it represented by *Cardinalis virginianus*, *Pipilo erythrophthalmus*, *Spizella pusilla* and *Cyanospiza cyanea*; few, if any, other *Fringillidæ* ever occurring at this season in the bottom-lands along with these species.

In addition to the foregoing, few birds are likely to be met with during the sultry mid-day; but towards evening, when their retreats grow cooler, every variety of animal life wakens into activity. Squirrels (*Sciurus ludovicianus* and *S. carolinensis*) scamper through the tree-tops; several species of *Cicada* deafen the ear with their screeching, trilling and sawing notes; and birds which have been hidden and silent during the warmer part of the day leave their places of concealment and become noisy. The *pzeet*, *tsip* and *pit* of various warblers is heard among the canes or the spice-wood bushes; the peerless whistlings of the *Thryothorus ludovicianus* and the rich song of the *Seiurus ludovicianus* — so full of power and sweetness — is heard from a neighboring swamp. Perched upon the outstretched arms of a huge sycamore, whose old, dead, snow-white branches overhang a lagoon, sits a great crested fly-catcher (*Myiarchus crinitus*), uttering the screaming whistles and irritable twitter so characteristic of the species and so much in harmony with the wildness of a virgin forest. Parakeets (*Conurus carolinensis*) occasionally commence their screeching notes, and now and then a solitary individual — more rarely a small flock — dashes by as it pursues its rapid, erratic flight through the trees. Oftener, however, they may be heard on every hand, but the closest and most persevering search will fail to discover one of them, since their green color renders it almost impossible to distinguish them from the thick foliage in which they are hidden. The yelping "log-cock," or "black wood-cock" (*Hylotomus pileatus*) is sure to be now and then seen or heard, while a glimpse at a noble ivory-bill (*Campephilus principalis*) is a possible sight. As the evening shades thicken, and the stars come out, the melancholy notes of the whip-poor-will (*Antrostomus vociferus*) are heard, occasionally answered by the louder voice of the chuck-will's-widow (*A. carolinensis*); at intervals we hear the plaintive, wailing notes of the wood pewee (*Contopus virens*), and the monotonous lisping note of the *Empidonax acadicus*; while the utterances of these twilight birds— all expressive of great solitude — are accompanied by the rasping of the katydids and the chirp of crickets. These nocturnal voices of the forest of the bottom-lands continue without intermission through the night, though in the neighborhood of the bayous or "ponds" they are drowned by the chorus of frogs, whose notes range from the delicate *peep* of a warbler to the hoarse bellowing of a bull. These, in turn, are frightened to silence by the harsh discordant squawk of the great blue heron (*Ardea herodias*), as, startled, he flies up at one's approach. Before the frogs resume their clatter one hears the little screech owl (*Scops asio*) wailing tremulously. The loud echoing hoot of the barred owl (*Syrnium nebulosum*), and the hoarser, more gutteral utterance of the great horned owl (*Bubo virginianus*), are heard at intervals until morning, when they are relieved by the gobbling and yelping of the wild turkeys (*Meleagris sylvestris*) and the various notes of the other birds which usher in the day.

PART II. *Consideration of Climatic Influence upon Color, as manifested in the Birds of the Lower Wabash Valley.*

The law of increased intensity of color to the southward is already well understood;[1] and that the birds of the Mississippi Valley are more brightly colored than individuals of the same species from parallel latitudes on the Atlantic coast is another law which Mr. Allen's observations in Eastern Kansas have developed and which my own in Southeastern Illinois confirm. On pages 113 and 115 of Mr. Allen's paper, cited at the beginning of this article, that gentleman tells us that "in the woodlands of Eastern Kansas a decided general tendency to a greater intensity of color than at the northward was noticed, in accordance with the law of the increase in intensity of color to the southward, which in several species was especially marked. The males of the common indigo bird (*Cyanospiza cyanea*) were not only much more than ordinarily lustrous, but the females shared the blue tint of the males to an unusual degree." The cardinal found there "makes a decided approach to the thick-billed race of this bird found in Lower California (*C. igneus* auct.)."

In regard to this law there is a striking analogy, with minor distinctive features to be noted afterwards, between Eastern Kansas and Southeastern Illinois. Specimens of *Cardinalis virginianus* from Mt. Carmel and Olney are as intensely red as those from Florida while this tint is at the same time much purer; they have also about the same general size and form, while the dimensions of the bill are similar. Males of *Pyranga æstiva*[2] are of a far richer vermilion than those from Washington, D.C., and resemble more nearly examples from tropical America. *Centurus carolinus* frequently has the entire lower parts tinged with red, the belly bright scarlet, and the lower part of the head strongly tinged with the same color; the amount of this red tinge is about the same as in the Florida form, but its tint is a pinkish scarlet mixed with salmon-pink, instead of dingy purplish, on a duller ground. *Melanerpes erythrocephalus* often has the abdomen strongly washed with salmon-pink, with touches of brighter reddish. In males of *Geothlypis trichas* the yellow of the lower parts is generally nearly continuous, being seldom interrupted by a large creamy-whitish abdominal area, as is universally the case in specimens from the States along the Atlantic Coast. In this feature they incline decidedly to *G. melanops* Baird (= var. *melanops* — see Am. Journ. Sci. and Arts, Dec., 1872) from Eastern Mexico. The quail (*Ortyx virginianus*) is represented by a style intermediate between that of Southern Florida (var. *floridanus* Coues) and the common form of the New England and Middle States. Many males have as much black as the Florida birds, but less plumbeous and more rufous. One (No. 961), in my own collection, from Mt. Carmel, has the black jugular collar almost as wide as in the var. *cubanensis*, from Cuba and the bill is as large as that of any Florida example with which it has been compared. In general size the quails of Southern Illinois average a trifle larger than those from Florida.

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[1] In this connection see especially the following works:—

ALLEN, Bull. Mus. Comp. Zool., II, No. 3, pp. 233–236.—*Ib.*, Do., Vol. III, No. 6, p. 114.—*Ib.*, Proc. Bost. Soc. Nat. Hist., Vol. XV, pt. 2, Dec., 1872, p. 214.

RIDGWAY, Am. Journ. Sci. and Arts, 3d ser., Vol. IV, Dec., 1872, p. 454; Jan., 1873, p. 39.—*Ib.*, American Naturalist, Sept., 1873, p.

COUES, Am. Nat., July, 1873, p. 417.

[2] In the Colorado province of the United States and the contiguous portions of Western Mexico, is a well-marked geographical race of this species, characterized by much larger size, and purer, though lighter, red colors. In the opinion which they pass upon its merits as a valid race, several authors (see Coues' "Key to North American Birds" p. 111, and Maynard's "Birds of Florida." pt. III, p. 85) are at fault, evidently because their conclusions were not supported by the examinations of specimens and comparison of them with the eastern form. Dr. Coues has made this comparison since the publication of his "Key," and the race is consequently recognized in his later "Check List" (p. 23, No. 108*a*); but for the benefit of those who persist in ignoring it, the following facts are presented: (1.) Eastern specimens

It is somewhat difficult to decide to which district — the Gulf Coast or the Plains — the lower Wabash Valley inclines most in the matter of climatic variation in color, its intermediate geographical location making it rather neutral in this respect. After careful study, however, it has been found that in the birds of the densely wooded portions the Gulf-coast impress is more marked, while on those of the prairies the modifications characteristic of the Plains are more perceptible.

of var. *æstiva never approach* the characters of var. *cooperi*, and it is only in Middle Mexico and on the Upper Rio Grande, that the two begin to intergrade, which they there do just like all other con-specific regional representatives along the line of junction of the provinces they respectively inhabit. (2.) Having seen a sufficient number of specimens of both forms, I am prepared to maintain that the characters of var. *cooperi* are as tangible and constant as those of any other geographical form of any American species. Indeed, they are so apparent that the type specimens are labelled in Dr. Coues' own handwriting "*P. hepatica*," which would seem to suggest that they looked somewhat different to him from *P. æstiva*. The form was also mentioned under the name of "*Pyranga hepatica* Swains.," in his "Prodrome of a work on the Ornithology of Arizona Territory" (p. 35).

The *P. cooperi* is a large-billed, long-winged, long-tailed race, peculiar to Western Mexico and the Arizona district, and holds an exactly parallel relation to *P. æstiva* that *Myiarchus cooperi* of the same region does to *M. irritabilis* of Eastern Mexico.

As above noted, quails from the heavily-wooded portions in the vicinity of the Wabash River exhibit the dark colors and thick bills of the Florida specimens; on the other hand, those from the wide prairies of the central and western portions of the State incline almost as decidedly toward var. *texanus* of the southwestern plains; the latter is typical as far north as the Republican River, in Kansas. The shrike (*Collurio*) is apparently much more like *excubitoroides* than *ludovicianus*, since I have yet to see a specimen from Southern Illinois — even from the immediate vicinity of the Wabash River — which inclines at all toward the Gulf-coast form.

The Cardinal (*Cardinalis virginianus*) has the size and exact proportions throughout of the Florida bird; but the colors are very much purer though equally intense. In colors the resemblance is closer to specimens from the Rio Grande, which, however, incline more toward var. *coccineus*, of Eastern Mexico, in possessing a more robust bill and narrower black frontlet. The difference from the Kansas form is very remarkable considering the nearness to each other of the two localities. I have examined Mr. Allen's specimens from Ft. Leavenworth, and they seem to be almost typical var. *igneus*! The *Peucæa æstivalis* is precisely like that from Florida and Georgia. In Kansas they have, apparently, only *P. cassini*, a very distinct species. Among the chickadees I have never seen a specimen which inclined toward *P. atricapillus*, much less toward var. *septentrionalis*; all are *P. carolinensis*, a very distinct species.

In regard to the meadow larks (*Sturnella*) some very curious facts have been observed bearing directly upon the nature of the relationship which the *S. magna* and *S. neglecta* bear to each other. Throughout the wooded districts all these birds are pure *magna*, with songs and other notes precisely like those of the same species found along the Atlantic coast, and not approaching in the least degree, either in habits, notes or plumage, the *S. neglecta*. In size they are more like those from Florida than those from more nearly the same latitude to the eastward, while their colors are slightly purer, richer, and more sharply contrasted; but there is no tendency to the peculiar features of *S. neglecta*. On the prairies, however, the songs of meadow larks may be heard which I have been unable to distinguish from those of the western birds, and they are very probably of that species. These songs are in the proportion of about one to half a dozen listened to in the course of an hour, the others being the ordinary notes. Whether these birds with the song of *S. neglecta* are really that species or merely denote the commencement of modifications toward that form, I have failed to decide by the securing of specimens. I strongly incline to the opinion that the former is really the true state of the case, since in Southern Iowa the two species occur together on the same prairies, and yet each preserves its own characteristics of habits, notes, etc., without mixing or otherwise interfering with the other. (In this connection see T. Martin Trippe, in Proc. Bost. Soc. Nat. Hist., Vol. XIV, pt. ii, Dec., 1872, p. 229.)

PART III. *The times of Migrating and Nesting of the Birds of the Lower Wabash Valley.*

The return of the birds which have passed the winter to the southward commences almost with the year, but the species that arrive in January are those which in mild winters are resident, such as *Rhinogryphus aura*, *Ectopistes migratoria*, and various water-fowl. February ushers in but few land-birds, the *Seiurus ludovicianus* being about the only true non-resident one. In March they begin to arrive in earnest, and from this the number increases until about the 20th of April, after which there is a gradual falling off, but very few species making their first appearance in May. The height of the "warbler season" is about the 20th of April, when the fruit trees, both cultivated and wild, are in full blossom, during which time the trees literally swarm with the various species of this tribe, engaged in catching the insects which infest the flowers. The summer sojourners do not begin to depart until about the middle of September, but by the end of that month the majority of them are gone. *Dendroica dominica* remains until the 13th of September; *D. æstiva* until the 27th; *Seiurus aurocapillus*, *Vireo flavifrons*, *V. olivaceus* and *Oporornis formosus* remain until well along in October; *Dendroica palmarum* has been shot October 15th; *Trochilus colubris* was observed Oct. 1st; *Chætura pelagica* stays as late as Oct. 20th; *Stelgidopteryx serripennis* has been observed on the 17th; *Galeoscoptes carolinensis* on the 15th; *Cyanospiza cyanea* about the 15th; *Guiraca cærulea* on the 6th; *Contopus virens* on the 15th; *Coccygus erythrophthalmus* on the 19th; *C. americanus* on the 15th. The return southward of species which breed farther north commences before the summer sojourners begin to leave. *Empidonax minimus* and *Seiurus noveboracensis* are common in August, but these two species may possibly nest in small numbers. The latter sometimes remains through mild winters. Most of the winter birds come in October, but in one season the snow bird *Junco* *hyemalis* arrived as early as September 26th, though another season it had not appeared as late as the 20th of October. None of them remain longer than the early part of April, the last lingering individuals of the snow bird and purple finch (*Carpodacus purpureus*) departing by the 10th.

It is a curious fact, and one which perhaps has been noted before, that many species of the migratory warblers pass northward through the country east of the Alleghanies and return southward through the Mississippi Valley, and *vice versa*. *Dendroica castanea*, *D. blackburniæ*, *D. maculosa* and *Myiodioctes canadensis* are abundant in autumn, but I have never seen a specimen of either in the spring, when all are common in the Atlantic States. On the other hand, *Perissoglossa tigrina*, *D. cœrulescens*, *D. palmarum* and *Oporornis agilis*, are more or less abundant in spring, but rare or wanting in autumn. *D. pennsylvanica*, though it comes in spring and remains all summer, is yet abundant only in the fall when the young (in the green and white plumage) in some years outnumber all the other species together. According to Mr. Brewster it has never been taken in this plumage in Massachusetts.

The following table of migrations is condensed from the record of four years' observations at Mt. Carmel, and shows the earliest and latest arrival of sixty-two species noted during that time.

TABLE OF MIGRATIONS.

Spring Arrivals.

Species marked with an asterisk (*) sometimes remain all winter.

1.	**Anas boschas.*	January 15.
2.	**Ectopistes migratoria.*	“ 15–Feb. 25.
3.	**Dafila acuta.*	“ 20.
4.	**Branta canadensis.*	“ 20–Feb. 14.
5.	**Mergus americanus.*	“ 20.
6.	**Spatula clypeata.*	“ 20.
7.	**Aythya americana.*	“ 25.
8.	**Nettion carolinensis.*	February 1.
9.	**Mareca americana.*	“ 18–28.
10.	*Seiurus ludovicianus.*	“ 20.
11.	**Aix sponsa.*	“ 25.
12.	**Querquedula discors.*	“ 28.
13.	**Grus canadensis.*	March 1–4.
14.	* “ *americanus.*	“ 6.
15.	**Bucephala albeola.*	“ 1.

16.	*Graculus floridanus.*	March 1–7.
17.	**Charadrius virginicus.*	“ 12.
18.	*Spizella socialis.*	“ 13–19; remains until Sept. 20.
19.	*Actodromus maculatus.*	“ 15.
20.	*Tachycineta bicolor.*	“ 15–24; remains until Sept. 20.
21.	*Progne subis.*	“ 20–28; remains until Sept. 8.
22.	**Harporhynchus rufus.*	“ 21–26.
23.	**Actiturus bartramius.*	“ 28.
24.	*Regulus calendula.*	April 1–9.
25.	*Mniotilta varia.*	“ 1–15.
26.	*Hirundo horreorum.*	“ 2–5.
27.	*Polioptila cærulea.*	“ 2–10; remains until Sept. 20.
28.	*Chætura pelagica.*	“ 3–11; remains until Oct. 20.
29.	*Numenius longirostris.*	“ 4.
30.	*Stelgidopteryx serripennis.*	“ 8–12; remains until Oct. 17.
31.	*Dendroica dominica.*	“ 9–18; remains until Sept. 13.
32.	*Petrochelidon lunifrons.*	“ 10–20; remains until Sept. 20.
33.	*Dendroica æstiva.*	“ 14–22.
34.	*Vireo noveboracensis.*	“ 15.
35.	*Tyrannus carolinensis.*	“ 15–21; remains until Sept. 9.
36.	*Dendroica palmarum.*	“ 16–23; remains until Oct. 15.
37.	*Antrostomus vociferus.*	“ 17.
38.	**Galeoscoptes carolinensis.*	“ 18–24; remains until Oct. 5.
39.	*Icterus baltimore.*	“ 19–22; remains until Sept. 14.
40.	“ *spurius.*	“ 19–25.
41.	*Cyanospiza cyanea.*	“ 19; remains until Oct. 15.
42.	*Vireo flavifrons.*	“ 19; remains until Oct. 15.
43.	*Empidonax traillii.*	“ 19.
44.	“ *acadicus.*	“ 19.
45.	*Myiarchus crinitus.*	“ 19–26; remains until Sept. 10.
46.	*Turdus mustelinus.*	“ 19–21; remains until Oct.
47.	*Vireo philadelphicus.*	“ 20.
48.	*Pyranga rubra.*	“ 20–23; remains until Sept.
49.	“ *æstiva.*	“ 20–29; remains until Sept. 27.
50.	*Geothlypis trichas.*	“ 20–30; remains until Sept. 16.
51.	*Euspiza americana.*	“ 22–30.
52.	*Vireo olivaceus.*	“ 22; remains until Oct. 15.
53.	*Protonotaria citrea.*	“ 23.
54.	*Icteria virens.*	“ 23–May 4.
55.	*Dendroica pennsylvanica.*	“ 26.
56.	*Oporornis formosus.*	“ 28; remains until Oct. 15.

57.	*Dolichonyx oryzivorus.*	April 29–May 7.
58.	*Coccygus americanus.*	“ 29–May 14.
59.	*Chordeiles popetue.*	May 2–8.
60.	*Dendroica tigrina.*	“ 3.
61.	*Contopus virens.*	“ 6–7; remains until Oct. 15.
62.	*Hedymeles ludovicianus.*	“ 8; remains until Oct.

Autumnal Arrivals.

1.	*Sphyropicus varius.*	September 15–29.
2.	*Ampelis cedrorum.*	“ 18.
3.	*Junco hyemalis.*	“ 26–Oct. 21.
4.	*Eremophila alpestris.*	“ 26–Oct. 12.
5.	*Certhia americana.*	“ 29–Nov. 2.
6.	*Dendroica coronata.*	October 1–4.
7.	*Sitta canadensis.*	“ 2.
8.	*Regulus satrapa.*	“ 2.
9.	*Melospiza palustris.*	“ 8.
10.	*Zonotrichia albicollis.*	“ 9–10.
11.	*Carpodacus purpureus.*	“ 20—Nov. 8.
12.	*Zonotrichia leucophrys.*	“ 15.
13.	*Spizella monticola.*	“ 20—Nov. 1.
14.	*Curvirostra americana.*	“ 22.
15.	*Passerella iliaca.*	“ 27.
16.	*Anthus ludovicianus.*	September 15.
17.	*Troglodytes hyemalis.*	“ 3–Dec. 25.
18.	*Aquila canadensis.*	“ 5.
19.	*Melospiza melodia.*	October 15.
20.	*Plectrophanes lapponicus.*	“ 20.

In order to show the relation between the return of birds from the south and the vernal change in the vegetation, I give the following dates of the leafing and flowering of plants at Mt. Carmel, as noted in the spring of 1872.[1] They hardly show the usual time of these species, for the season happened to be one later than usual.

Species.	*Date of leafing.*	*Date of flowering.*
Acer rubrum.	April 12.	March 20.
“ *dasycarpum.*	“ 12.	April 8.
“ *sacharrinum.*	“ 15.	——— —
Carya alba.	“ 13.	——— —

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[1] From observations made by Dr. J. Schneck.

Species.	*Date of leafing.*	*Date of flowering.*
Cercis canadensis.	April 20.	April 10.
Prunus serotina.	“ 5.	“ 25.
Cornus florida.	“ 20.	—— —
Fraxinus americana.	—— —	April 12.
Liriodendron tulipifera.	April 4.	—— —
Persica vulgaris.	“ 20.	April 12.
Pyrus malus.	“ 13.	“ 20.
Quercus alba.	“ 13.	—— —
Syringa vulgaris.	“ 19.	April 12.
Ulmus americana.	—— —	March 20.
Aquilegia canadensis.	April 20.	—— —
Claytonia virginica.	“ 6.	April 12.
Erythronum americanum.	“ 20.	—— —
Geranium maculatum.	“ 25.	—— —
Hepatica triloba.	—— —	March 31.
Iris versicolor.	April 13.	—— —
Podophyllum peltatum.	March 30.	—— —
Rubus villosus.	April 10.	—— —
Sambucus canadensis.	March 20.	—— —
Sanguinaria canadensis.	April 12.	April 14.

As the peach ordinarily blooms at Mt. Carmel about the twentieth of March — sometimes even as early as the first of that month — it must be borne in mind that the spring of 1872 was unusually backward and that the first leafing and flowering of the above species usually takes place two or three weeks earlier than the dates above given.

The nesting season begins with March and ends in October, though only one species (*Ortyx virginianus*) has been noticed breeding in the latter month and but a few (*Corvus americanus* and certain *Raptores*) in the former. From the middle of April to the middle of June is the most productive season to the oölogist. Eggs of *Buteo borealis* have been obtained at Mt. Carmel on the sixth of March, the nest being commenced early in February. On the first of April *Cyanura cristata*, *Turdus migratorius*, *Sialia sialis* and *Parus carolinensis* often have eggs, while *Sayornis fuscus*, *Harporhynchus rufus*, *Ceryle alcyon*, *Quiscalus æneus* and a few others are building their nests. *Collurio excubitoroides*, *Zenaidura carolinensis*, *Cardinalis virginianus* and *Spizella socialis* also lay their first eggs in April, either of them often as early as the middle of the month. All the other species nest in May, June and July, though in the latter month very few nests indeed — and those chiefly of *Zenaidura carolinensis*, *Ortyx virginianus* and *Chordeiles popetue* — can be found. The first of these nests until the latter part of September, while of the next species I have found a nest full of eggs in the early part of October.

PART VI. *Catalogue of the Birds of the Lower Wabash Valley, arranged according to their Relation to the Seasons; with Summary.*

The following tables are believed to express very nearly the relationship of the seasons to the several groups of birds characteristic of each. They will of course be modified to some extent by the results of future observations, but the fact that they have been drawn up from the experience of several years' continued observations warrants the belief that they are approximately accurate.

A. — SPECIES FOUND IRRESPECTIVE OF SEASONS.

a. Regularly resident — all breeding.

	Equally abundant at all seasons.	*Most abundant in summer.*	*Most abundant in winter.*	*Most abundant in spring and fall.*
1. *Turdus migratorius.*				1
2. *Mimus polyglottus.*		1		
3. *Sialia sialis.*		2		
4. *Lophophanes bicolor.*	1			
5. *Parus carolinensis.*	2			
6. *Sitta carolinensis.*			1	
7. *Thryothorus ludovicianus.*	3			
8. *Thryomanes bewickii.*		3		
9. *Telmatodytes palustris.*		4		
10. *Troglodytes œdon.* (?)[1]		5		
11. *Collurio excubitoroides.*	4			
12. *Chrysomitris tristis.*			2	
13. *Poocœtes gramineus.*				2
14. *Passerculus savanna.*				3
15. *Spizella pusilla.*		6		
16. *Cardinalis virginianus.*	5			
17. *Pipilo erythrophthalmus.*	6			
18. *Eremophila alpestris.*			3	
19. *Molothrus pecoris.*		7		
20. *Agelaius phœniceus.*		8		
21. *Xanthocephalus icterocephalus* (?).		9		

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[1] These queries signify that it is not absolutely certain that the species are found throughout the year.

		Equally common at all seasons.	*Most common in summer.*	*Most common in winter.*	*Most common in spring and fall.*
22.	*Sturnella magna.*	7			
23.	" *neglecta.*	8			
24.	*Quiscalus æneus.*		10		
25.	*Cyanura cristata.*	9			
26.	*Corvus carnivorus.*	10			
27.	" *americanus.*	11			
28.	*Sayornis fuscus.*		11		
29.	*Ceryle alcyon.*		12		
30.	*Campephilus principalis.*	12			
31.	*Picus villosus.*			4	
32.	" *pubescens.*			5	
33.	*Hylotomus pileatus.*	13			
34.	*Centurus carolinus.*	14			
35.	*Melanerpes erythrocephalus.*	15			
36.	*Colaptes auratus.*	16			
37.	*Conurus carolinensis.*	17			
38.	*Strix pratincola.*		13		
39.	*Syrnium nebulosum.*	18			
40.	*Bubo virginianus.*	19			
41.	*Scops asio.*	20			
42.	*Falco sparverius.*	21			
43.	*Circus hudsonius.*			6	
44.	*Nisus cooperi.*	22			
45.	" *fuscus.*	23			
46.	*Buteo borealis.*	24			
47.	" *lineatus.*	25			
48.	*Haliaëtus leucocephalus.*			7	
49.	*Pandion carolinensis.*		14		
50.	*Rhinogryphus aura.*		15		
51.	*Ectopistes migratoria.*				4
52.	*Zenaidura carolinensis.*		16		
53.	*Meleagris sylvestris.*	26			
54.	*Bonasa umbellus.*	27			
55.	*Cupidonia cupido.*	28			
56.	*Ortyx virginianus.*	29			
57.	*Ægialitis vociferus.*		17		
58.	*Philohela minor.*		18		
59.	*Gallinago wilsoni.*				5
60.	*Actiturus bartramius.*		19		
61.	*Tringoides macularius.*		20		
62.	*Rhyacophilus solitarius.*		21		
63.	*Botaurus lentiginosus.*		22		

		Equally common at all seasons.	*Most common in summer.*	*Most common in winter.*	*Most common in spring and fall.*
64.	*Grus canadensis.*				6
65.	*Rallus elegans.*		23		
66.	" *virginianus.*		24		
67.	*Porzana carolina.*		25		
68.	*Fulica americana.*		26		
69.	*Aix sponsa.*		27		
70.	*Lophodytes cucullatus.*				7
71.	*Erismatura rubida.*				8
72.	*Anas boschas.*				9

b. Irregularly resident — breeding doubtful.

1. *Falco polyagrus.*
2. " *anatum.*
3. " *columbarius.*
4. *Buteo pennsylvanicus.*
5. " *swainsoni.*

SUMMARY OF RESIDENT SPECIES.

As abundant at one season as another	29	species.
Most abundant in summer	27	"
Most abundant in winter	7	"
Most abundant during spring and fall migrations . .	9	"
Found irregularly throughout the year	5	"
Total number of species permanently resident	77	

B. — Species found only in Summer.

a. Summer sojourners — all breeding.

1.	*Turdus mustelinus.*	Abundant.
*2.	*Harporhynchus rufus.*	"
*3.	*Galeoscoptes carolinensis.*	Very abundant.
4.	*Polioptila cœrulea.*	Abundant.
5.	*Cistothorus stellaris.*	Common ?

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* The species marked with an asterisk probably occasionally remain all winter.

6.	*Mniotilta varia.*	Abundant.
7.	*Protonotaria citrea.*	“
8.	*Helmitherus vermivorus.*	Common.
9.	*Helminthophaga pinus.*	Abundant.
10.	“ *chrysoptera.*	Not common?
11.	*Parula americana.*	“
12.	*Dendrœca æstiva.*	Very abundant.
13.	“ *pinus.*	Not common.
14.	“ *discolor.*	“
15.	“ *dominica.*	Common.
16.	“ *cærulea.*	Very abundant.
17.	“ *pennsylvanica.*	Not common.
18.	*Seiurus aurocapillus.*	Abundant.
19.	“ *ludovicianus.*	“
20.	*Oporornis formosus.*	“
21.	*Geothlypis philadelphia.*	Not common.
22.	“ *trichas.*	Abundant.
23.	*Icteria virens.*	“
24.	*Myiodioctes mitratus.*	Common.
25.	*Setophaga ruticilla.*	Abundant.
26.	*Progne subis.*	Extremely abundant.
27.	*Petrochelidon lunifrons.*	“ “
28.	*Hirundo horreorum.*	Abundant.
29.	*Tachycineta bicolor.*	Very abundant.
30.	*Cotyle riparia.*	Common.
31.	*Stelgidopteryx serripennis.*	Extremely abundant.
32.	*Vireosylvia olivacea.*	Abundant.
33.	“ *gilva.*	“
34.	*Vireo noveboracensis.*	“
35.	“ *bellii.*	Common.
36.	*Lanivireo flavifrons.*	Abundant.
37.	*Pyranga rubra.*	Very common.
38.	“ *æstiva.*	Abundant.
*39.	*Coturniculus passerinus.*	“
*40.	“ *henslowi.*	“
41.	*Chondestes grammaca.*	“
42.	*Spizella socialis.*	Very abundant.
*43.	*Peucæa æstivalis.*	Common.
44.	*Euspiza americana.*	Very abundant.
45.	*Guiraca cærulea.*	Rare?

46.	*Cyanospiza cyanea.*	Abundant.
47.	*Icterus baltimore.*	“
48.	“ *spurius.*	“
49.	*Tyrannus carolinensis.*	“
50.	*Myiarchus crinitus.*	“
51.	*Contopus virens.*	“
52.	*Empidonax acadicus.*	“
53.	“ *traillii.*	Common.
54.	*Chordeiles popetue.*	“
55.	*Antrostomus carolinensis.*	“ ?
56.	“ *vociferus.*	Abundant.
57.	*Chætura pelagica.*	Excessively abundant.
58.	*Trochilus colubris.*	Very abundant.
59.	*Coccygus americanus.*	Very common.
60.	“ *erythrophthalmus.*	Not common.
61.	*Nauclerus forficatus.*	Very abundant.
62.	*Ictinia mississippiensis.*	Abundant.
63.	*Phalaropus wilsoni.*	Not common?
64.	*Ardea herodias.*	Abundant.
65.	*Herodias egretta.*	“
66.	*Garzetta candidissima.*	Rare?
67.	*Ardetta exilis.*	“
68.	*Butorides virescens.*	Abundant.
69.	*Nyctiardea gardeni.*	Rare?
70.	*Nyctherodias violaceus.*	Common?
71.	*Porzana noveboracensis.*	“ ?
72.	“ *jamaicensis.*	“ ?
*73.	*Gallinula galeata.*	“ ?
74.	*Graculus floridanus.*	Common.
75.	*Plotus anhinga.*	“
76.	*Sterna hirundo.*	Rare?
77.	“ *forsteri.*	“ ?
78.	“ *antillarum.*	“ ?
79.	“ *regia.*	“ ?
80.	*Hydrochelidon fissipes.*	Common.

b. Summer visitants—probably not breeding.

1. *Cyanospiza ciris.* 1 specimen, June, Wabash Co.
2. *Elanus leucurus.* 1 pair, July, Wabash Co.
3. *Asturina plagiata.* 1 specimen, Aug., Richland Co.
4. *Catharista atrata.* Occasional.

5. *Himantopus nigricollis.* Occasional.
6. *Recurvirostra americana.* “
7. *Tantalus loculator.* Common in latter part of summer and early fall.
8. *Ibis falcinellus.* Occasional.
9. *Florida cœrulea.* Occasional.
10. *Gallinula martinica.* “
11. *Chrœcocephalus atricilla.* “
12. *Pelecanus erythrorhynchus.* “

SUMMARY OF SUMMER BIRDS.

Found irrespective of seasons	75
Found only in summer	92
Total number of species found in summer	167
Of these probably not breeding	12
Number of species breeding	155

C. — FOUND ONLY IN WINTER.

a. Winter sojourners — regularly resident.

1.	*Regulus satrapa.*	Abundant.
2.	*Sitta canadensis.*	Sometimes very common.
3.	*Certhia americana.**	Common.
4.	*Troglodytes hyemalis.*	“
5.	*Anthus ludovicianus.*	Very abundant.
6.	*Dendroica coronata.*	Extremely abundant.
7.	*Seiurus noveboracensis.**	Common.
8.	*Ampelis cedrorum.**	Extremely abundant.
9.	*Carpodacus purpureus.*	“ “
10.	*Chrysomitris pinus.*	Usually very rare; sometimes common.
11.	*Zonotrichia leucophrys.*	Very abundant.
12.	“ *albicollis.*	“ “
13.	*Junco hyemalis.*	“ “
14.	*Spizella monticola.*	Extremely abundant.
15.	*Melospiza melodia.**	Very abundant.
16.	“ *palustris.**	Extremely abundant.
17.	*Passerella iliaca.*	Very common.

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* Species in this list marked with an asterisk may possibly breed in small numbers, since most of them may be occasionally seen during the summer.

18.	*Scolecophagus ferrugineus.*	Extremely abundant, at times.
19.	*Sphyropicus varius.**	Very common.
20.	*Fulix marila.*	Abundant.
21.	“ *affinis.*	“
22.	“ *collaris.*	“
23.	*Bucephala americana.*	“
24.	“ *albeola.*	“
25.	*Larus argentatus.*	“
26.	“ *delawarensis.*	“
27.	*Chrœcocephalus philadelphia.*	Common?
28.	*Colymbus torquatus.*	Abundant.
29.	“ *septentrionalis.*	Common?
30.	*Podiceps cornutus.*	“ ?
31.	“ *cristatus.*	“ ?
32.	“ *holbollii.*	“ ?

b. Winter visitants—of irregular occurrence.

1.	?*Parus atricapillus.*	Very rare?
2.	*Collurio borealis.*	“ “
3.	*Loxia americana.*	Sometimes common.
4.	“ *leucoptera.*	“ “
5.	*Pinicola canadensis.*	Extremely rare.
6.	*Ægiothus linaria.*	“ “
7.	*Plectrophanes nivalis.*	Extremely rare—accidental? (1 spec.)
8.	“ *lapponicus.*	Extremely abundant.
9.	“ *pictus.*	Common on the prairies.
10.	*Scolecophagus cyanocephalus.*	Accidental.
11.	*Nyctale acadica.*	Extremely rare?
12.	*Nyctea nivea.*	Common on the prairies.
13.	*Astur atricapillus.*	Rare.
14.	*Aquila canadensis.*	Rather common.
15.	*Archibuteo sanctijohannis.*	Abundant.

SUMMARY OF WINTER BIRDS.

Found irrespective of season	75
Found only in winter	47
Total number of species in winter	122

[The number much increased (to about 150) in mild winters by accessions from lists C. *b*, and D.]

D. Transient Visitors — (passing through in spring and fall).

1. *Turdus fuscescens.** Abundant.
2. “ *aliciæ.* “
3. “ *swainsoni.* “
4. “ *pallasi.*† “
5. *Regulus calendula.*† “
6. *Helminthophaga ruficapilla.* Very common. (Noted in fall.)
7. “ *celata.* Very common. (Most common in spring.)
8. “ *peregrina.* “ “ “ “ “
9. *Perissoglossa tigrina.* Common? (Spring.)
10. *Dendroica maculosa.* Abundant. (Most common in fall.)
11. “ *blackburniæ.* Common. “ “ “
12. “ *striata.* Abundant. “ “ “
13. “ *castanea.* Common. “ “ “
14. “ *cærulescens.* Common.
15. “ *virens.* Abundant. (Both spring and fall.)
16. “ *palmarum.* (Most common in spring.)
17. *Oporornis agilis.* Common? (Spring only?)
18. *Myiodioctes canadensis.* Abundant. (Most common in fall.)
19. “ *pusillus.* Not common.
20. *Vireosylvia philadelphica.* Rather common. (Noted in fall.)
21. *Lanivireo solitaria.* Very rare?
22. *Melospiza lincolni.* Rather common.
23. *Hedymeles ludovicianus.** Rather common.
24. *Dolichonyx oryzivorus.* Abundant.
25. *Empidonax minimus.** Common.
26. “ *flaviventris.* Rare?
27. *Squatarola helvetica.*
28. *Charadrius virginicus.* Abundant.
29. *Ægialitis melodus.*
30. “ *semipalmatus.*
31. *Macrorhamphus griseus.*
32. *Pelidna americana.*
33. *Actodromus bonapartei.* Abundant.
34. “ *maculatus.* “
35. “ *minutilla.** “

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* Species thus distinguished may occasionally breed, being seen, at times, during the summer.

† These species remain in very mild winters.

36. *Ereunetes pusillus.*
37. *Calidris arenaria.*
38. *Symphemia semipalmata.**
39. *Micropalama himantopus.*
40. *Gambetta melanoleuca.* Abundant.
41. " *flavipes.* "
42. *Tryngites rufescens.*
43. *Limosa fedoa.* Common.
44. " *hudsonica.* Common.
45. *Numenius longirostris.* Common.
46. " *hudsonicus.*
47. " *borealis.*
48. *Phalaropus hyperboreus.*
49. " *fulicarius.*
50. *Grus americanus.*
51. *Cygnus americanus.*
52. " *buccinnator.*
53. *Anser hyperboreus.*†
54. " *albatus.*†
55. " *cærulescens.*†
56. " *gambeli.*†
57. *Branta canadensis.*† Seen December 10th.
58. " *hutchinsi.*† Common.
59. " *bernicla.* Seen December 10th.†
60. *Anas boschas.** †
61. " *obscura.*†
62. *Dafila acuta.*†
63. *Nettion carolinensis.*†
64. *Querquedula discors.** †
65. *Mareca americana.*†
66. *Chaulelasmus streperus.*†
67. *Spatula clypeata.** †
68. *Aythya americana.*†
69. " *vallisneria.*†
70. *Mergus americanus.* †
71. " *serrator.*†
72. *Graculus dilophus.** † Common.

GENERAL SUMMARY.

Found irrespective of season	77
Found only in summer	92
" " winter	47
" " spring and fall	72
Total number of species	288
Number of species breeding,	about 155
Number of species wintering,	about 155

Second and final action was taken on the following change in the Constitution, Art. VI, viz.: that after the words "majority of votes," the words "of members present" be inserted, and the proposed change was adopted.

The thanks of the Society were voted to Mrs. J. J. Glover for a collection of paleontological, ethnological, and other specimens.

March 4, 1874.

The President in the chair. Forty persons present.

Mr. Bouvé introduced the subject of Dr. Genth's theory of the metamorphism of corundum, which has lately been published, and explained the meaning of the terms metamorphism and pseudomorphism as used in mineralogy, and, in concluding, called upon Dr. Hunt for his views on the question.

ON DR. GENTH'S RESEARCHES ON CORUNDUM AND ITS ASSOCIATED MINERALS. BY DR. T. STERRY HUNT.

The speaker, while praising the industry and chemical skill displayed in the paper of Dr. Genth, insisted upon the importance of some clear definitions as to replacement, alteration and association in the mineral kingdom, for the lack of which he conceived the learned author, in common with many others, had fallen into errors, and had been led to conclusions wholly untenable. The name of pseudomorphs, or false forms, is given to mineral masses resulting from very unlike processes. Of these, the first class has a very simple origin. In a vein where the process of filling up by deposition is occasionally varied by the opposite process of solution, the removal of certain crystals from their matrix leaves cavities which are afterwards filled up by another species. An example of this is seen in the well-known cubes of chalcedonic quartz cast in the moulds of fluorite. The silicification, or so-called petrifaction, of wood, is the result of a similar process. The pores of the wood are in the first place filled with silica, while the woody fibre remains. This is subsequently removed by decay, leaving a porous mass, the cast of the original spaces in the wood; but in many cases this, in its turn, becomes filled up, and there thus is at last produced a solid mass, in which both the pores and the fibre of the wood are represented by silica.

The second class of pseudomorphs is illustrated by the alteration of feldspar, and various feldspathides, which by a loss of protoxyd bases with a portion of silica, and the taking up of water, are converted into kaolin. The change of chalybite and pyrite into limonite, and of cuprite into malachite, are examples of similar processes; all of which take place under atmospheric influences.

Analogous alterations may be produced in veins as a result of changes in the composition in the circulating waters, as when crystals of pyromorphite, a phosphate of lead-oxyd, are converted into galena. Changes of this kind being effected from without, nuclei of the unaltered species are often found in the centre of the altered crystals. This process is obviously very different from replacement, and is properly designated epigenesis.

The notion of epigenic alteration has been extended to a great number of cases which have nothing in common either with it or with replacement, but are simply examples of the association or envelopment of different and unlike species. This envelopment is of two kinds: as an example of the first, carbonate of lime crystallizing from solution in the midst of silicious sand may include so much of this that the resulting crystals, though having the geometrical forms of calcite, contain less carbonate of lime than sand, as is seen in the so-called crystallized sandstone of Fontainebleau. The nature of the process is not, however, in all cases, so obvious as this; but it is clear, from numerous examples, that small proportions of certain substances may, in the act of crystallizing, give their own forms to large and predominating quantities of foreign matter. From the analysis of such mixtures chemists have concluded an epigenic change, more or less complete, of the crystal. A good example of this is seen in certain orthoclase crystals which include a large admixture of cassiterite. Besides these cases of asymmetrical envelopment, we have those of symmetrical envelopment. The occurrence of red tourmalines enclosed in green ones, and of muscovite in margarodite, are clearly cases of the deposition of one mineral upon another in the slow growth which takes place in veinstones. In these also, by a process which is often seen in the crystallization of certain species, such as saltpetre, hollow or skeleton crystals are formed. The crystals of tourmaline from Paris in Maine are in many cases prismatic tubes, which are either empty or filled with mica. In like manner, crystals of beryl are found which are filled with orthoclase, and similar shells of zircon and of galena enclose calcite. The envelope is often exceedingly thin, and in the case of some species may be removed by such selective solution as often takes place in mineral veins, leaving the enclosed mineral with the form of the mould.

The greater part of all the examples of replacement and envelopment known have been described as cases of pseudomorphism by epigenesis, and the advocates of the doctrine of transmutation have not hesitated to assert, upon this supposed evidence, the conversion of almost every mineral species into some other, and to extend this view to rock-masses, declaring that the great part of all the so-called metamorphic or crystalline rocks are the results of an epigenic process; a doctrine which has been embodied in the dictum of Prof Dana, that "regional metamorphism is pseudomorphism on a broad scale." For an illustration of this doctrine and its legitimate consequences, see the speaker's presidential address before the American Association for the Advancement of Science in 1871, and in the American Journal of Science for July, 1872, his reply to Dana's criticisms thereon.

While the advocates of this doctrine maintain that a mass of granite or diorite may be converted into serpentine or limestone, and that a limestone may be changed into granite or gneiss, which may, in its turn, become serpentine, it is evident that it makes little difference what mineral species is taken for the starting point. Dr. Genth, unlike his predecessors, takes his departure from corundum, and from various facts in the association and envelopment of minerals found accompanying it, is led to conclude that there have been formed from it by epigenesis spinel, tourmaline, fibrolite, cyanite, paragonite and other micas, chlorite, and probably various feldspars. According to him great beds of micaceous and chloritic schists have resulted from the transformation of corundum, and even the beds of bauxite, a mixture of hydrous aluminic and ferric oxyds allied to limonite, which abounds in certain tertiary deposits, were once corundum or emery, from which they have been derived by a retrograde metamorphosis; a striking example of the strange conclusions to which this doctrine of epigenic pseudomorphism may lead.

The speaker had not only carefully studied Dr. Genth's paper, but through the courtesy of this gentlemen, had examined with him the extensive collection of specimens upon which the conclusions announced by Dr. Genth have been based, and while bearing testimony to his accuracy and skill as a chemist and mineralogist, maintained that all of the phenomena in question are nothing more than examples of association and envelopment, as above explained. All of the facts regarding the corundum-bearing veins described by Dr. Genth, have their parallels in the granitic veins with beryl and tourmaline, so common in the Montalban, or White Mountain rocks of North America, and in the calcareous veinstones, with apatite, pyroxene, phlogopite, and graphite, of the Laurentian rocks, both of which classes of veins have elsewhere been described by the author.

Dr. S. Kneeland exhibited a dress and pouch made by the natives of the Gold Coast, Africa, and several photographs of the Ashantees and Fantees, now brought to notice by the war between the former and the English.

The Ashantees are on that portion of the Gold Coast, in Upper Guinea, bounded north by the Kong Mts., south by the Atlantic, east and west by large rivers, from 5° to 9° 30′ North latitude. Since the beginning of this century, they have been the most powerful kingdom of native Africans, having reduced the Fantees, between them and the sea, to subjection, and having had several encounters with the English on the coast, almost always gaining the victory, and when defeated causing heavy loss to the enemy. They number more than a million people, and their soil is extremely fertile; they are ingenious manufacturers, and export large quantities of gold dust, no doubt washed down from the Kong Mts. to the north.

The Fantees are on the coast, of which the interior region is occupied by the Ashantees. Their country is also fertile and populous, and they have important trading stations on the coast; they are a fine looking race, more muscular but less warlike than the interior tribes, and are known by the small scarifications on the back of the neck and upper part of the cheeks.

A few years ago they became involved in a war with the Ashantees, and obtained the aid of the English, who had a small fort in one of their towns; but, in spite of this aid they were overpowered, and the whole country became a part of the Ashantee empire, with the consent of the English.

Cape Coast Castle is the capital of the British settlements on the coast of Guinea, and has a population of about 10,000. The town is irregularly built; the climate is very damp and unhealthy, and is more deadly to the invading whites than the weapons of the native tribes. From this are exported gold dust, palm oil and tortoise shell, brought down by the natives. There are strong fortifications on a granite rock projecting into the sea, once nearly taken by the Ashantees.

Before the English, the Dutch paid a subsidy for the privilege of the trade; the former refused to pay the subsidy, and to allow the Ashantees free trade with the coast. The Ashantees attacked the Fantees, and drove them into Coast Castle, under the very guns of the English, who were obliged to assist the Fantees — hence the present war. The stories of the English victories he believed greatly exaggerated, as this warlike and numerous people, aided by their unhealthy climate, would render any victory, and especially the capture of Coomassie, their capital, a dearly bought one.

The sand in the streets of the coast towns, and the sand on the shore, is rich with gold; the natives work the gold-bearing earth till it caves in, and then they leave it, fearing the displeasure of their gods, which they think is thus displayed. The nuggets belong to the king, the dust to the people. The king of Ashantee is allowed three thousand three hundred and thirty-three wives; a photograph of one of whom was presented, also others of Ashantee musicians and Fantee princesses. The dress and pouch were made by the Mandingoes, an interior tribe to the north of Liberia; they are very skilful tanners and workers in leather, using for tanning the bark of the mangrove.

March 18, 1874.

The President in the chair. Sixty-one persons present.

The following papers were read: —

Dr. Samuel Kneeland read a paper illustrated by diagrams and specimens, on the "Evidence for and against the existence of the so-called sea-serpent."

Though an animal so named has been seen by many credible witnesses on the coasts of Norway and New England, and has been popularly believed in for centuries, all the researches of naturalists have failed to discover any remains of such a creature, or to obtain any satisfactory information as to its size, proportions, appearance, or habits. There is, doubtless, much exaggeration in the popular descriptions of the animal; but in view of the great mass of testimony in favor of its existence, the fact that we are by no means cognizant of all the forms of life in the ocean, and also the certainty that in former geological ages more than one type existed to which this animal may bear some resemblance, it is fair to assume that there may be a portion of truth at the foundation of this question.

After tracing the history of the animal from Pontoppidan in the middle of the 18th century to the present time, and enumerating the numerous references to its appearance in Europe and America, and quoting Prof. Owen's remarks against its existence, he brought in review the various alleged sources of error; none of these seemed to him probable, considering the practised eyes of the principal witnesses in marine objects.

After showing that this animal could not be referred to fishes nor to serpents, nor to any described form of living reptiles or mammals, he drew attention to the fact that many early geological types had been transmitted to the present time, with or without interruption — such as the Cestracion, Lepidosteus, Chimæra, Percopsis, Lingula, etc.

For the last thirty years it has been believed that the closest affinities of the "sea-serpent" were with the enaliosaurians of the secondary age, and especially with Plesiosaurus. The Mosasaurus, a marine saurian of the cretaceous epoch, seems to fill up still better the requirements of this animal.

Prof. Agassiz, in 1849, in a lecture in Philadelphia, is reported to have said, "I have asked myself whether there is not such an animal as the sea-serpent. There are many who will doubt the existence of such a creature until it can be brought under the dissecting knife; but it has been seen by so many on whom we may rely, that it is wrong to doubt any longer. The truth is that if a naturalist had to sketch the outlines of an Ichthyosaurus or Plesiosaurus from the remains we have of them, he would make a drawing very similar to the sea-serpent as it has been described. There is reason to believe that the parts are soft and perishable, but I still consider it probable that it will be the good fortune of some person on the coast of Norway or North America to find a living representative of this type of reptile, which is thought to have died out."

In his "Geological Researches," 1871, Prof. Agassiz writes, twenty-two years later, "If there exists any animal in our waters not yet known to naturalists, answering to the description of the 'sea-serpent,' it must be closely allied to the Plesiosaurus. The occurrence in the fresh waters of North America of a fish, the Lepidosteus, which is closely allied to the fossil fishes found with the Plesiosaurus in the Jurassic beds, renders such a supposition probable."

The undoubted rarity of such an animal would account for the failure of any fragment to find its way into collections; many cetaceans are so uncommon that only single specimens have ever been seen by naturalists, and some have been entirely unknown until within fifty years. Inhabiting the ocean, the chances of its body floating long enough for any part to be cast on shore would be very small; the rocky coasts which it seems to frequent are unfavorable for the accidental casting up of any fragment. In the present creation, were it not for the persecution of man, the bones of seals and whales, of the beaver, of the cougar, of monkeys and elephants, would hardly ever be found in the places thickly inhabited by them. The non-occurrence of any fragments, therefore, is of little weight in disproving the existence of an animal, even of man himself.

The cetacean Zeuglodon of the tertiary fulfils some of the indications of the prevalent idea of the sea-serpent, and there is no reason *à priori* why a slender and lengthened mammalian form should not exist among the present cetaceans. The marine saurians of the secondary were replaced by the marine mammals of the tertiary and present ages. On the generally admitted laws of palæontology there would be a greater probability of the Zeuglodon than of the Plesiosaurus type descending in a modified form to the present epoch; and either, in the vast expanse of ocean, might for ages escape the examination of naturalists. The probability is that this animal belongs either to some secondary form greatly modified, of enaliosaurians, perhaps intermediate between these and the ophidians, or to a tertiary Zeuglodont form, with reptilian affinities, like Elasmosaurus, intermediate between Plesiosaurus or Mosasaurus, and the elongated cetaceans.

He thought a careful weighing of the evidence showed that such an animal is not a zoological absurdity, and that from palæontology (if we discard the testimony of many credible witnesses), we may even conclude that it is a *possibility*—and, he believed, a *probability*—that some form, intermediate between the marine saurians of the secondary and the elongated cetaceans of the tertiary has come down to the present epoch, and will eventually come under the notice of naturalists, and prove, in this as in many other cases, that widely spread popular beliefs in natural history, especially when professing to rest upon credible testimony, have generally for their foundation some portion of scientific truth. He believed there were at least two species of the creature (which he styled *Eremotherium*), one in the northern and another in the southern ocean.

Dr. Hagen said that he had, in 1839, accompanied Prof. Rathke in his visit to Norway to collect evidence in regard to the sea-serpent, the reality of which no Norwegian doubts, and Dr. Hagen expressed himself convinced of its existence.

Notes on Ophidiidæ and Fierasferidæ, with Descriptions of New Species from America and the Mediterranean.

By F. W. Putnam.

OPHIDIUM.

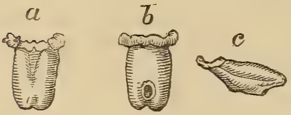
Two species of this very interesting genus inhabit our southern coasts. One of these, first mentioned by Mitchell, under the name of *Ophidium barbatum*, was afterwards described and figured under the name of *O. marginatum* by DeKay, from a single specimen taken in New York waters. The other species, which I believe to be undescribed, I name *O. Holbrookii*, in memory of the late Dr. J. E. Holbrook of Charleston, S. C., one to whom science is deeply indebted for the results of his labors on the reptiles of North America and on the fishes of our southern waters, and one whose memory is deeply cherished by those who were honored with his friendship.

Ophidium marginatum DeKay.

A single specimen of this rare fish is in the Agassiz Collection. It is in rather poor condition, but sufficiently well preserved to establish the fact that DeKay's description and figure are quite correct, and to enable the heretofore unknown character of the air-bladder to be made out and thus settle the validity of the species.

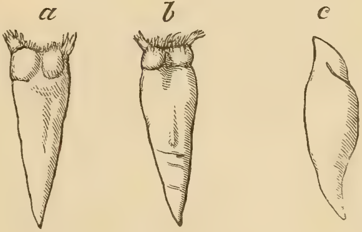
The species is very closely allied by its external characters to *O. barbatum* and *O. Broussonetii* from the Mediterranean, but differs in a very marked manner from them in its air-bladder.

The air-bladder, which is represented of natural size in the following cut (*a*, view from above; *b*, from below; *c*, from the side), is thick, flattened above, and bulging below, about two-thirds as wide as it is long; slightly contracted at its anterior portion, where it is closely united to three small, thin and flat bones, which penetrate its substance but do not enclose the side walls, by the extension of the lateral bones, as in *O. Vasalli.* Posteriorly the bladder is rounded, with a slight notch in the hind margin, and just forward of this notch, on the under side, is a round foramen covered by a very thin mucous membrane.



Ophidium Holbrookii sp. nov.

The only specimen I have seen of this species was collected by Mr. C. J. Maynard, at Key West, Florida, in 1872. Externally it cannot be distinguished from Mediterranean specimens of *O. Broussonetii*, with the exception that when placed side by side with them it is seen to be a slightly deeper fish. The barbels, length of the maxillary, proportions of the eye and of the head are about the same, and it also has the black margin to the dorsal and anal fins in common with several other species. The air-bladder, however, is of a different shape, being very long and pointed, with a posterior portion that is easily detached, while in *O. Broussonetii* the air-bladder is oval, and is quite firmly attached along the vertebral column. Had I examined but a single specimen of *O. Broussonetii* and a single specimen of *O. Holbrookii*, I should hardly have dared to consider the difference in the shape of the air-bladder as one that would prove of specific importance, but two specimens of *Broussonetii* agree precisely in their bladders, and the well known and singular variation of this organ in the species of the genus, as shown by the dissections of Müller, is quite convincing in the determination of the present species. As in *Broussonetii*, the front part of the bladder is firmly attached to the anterior vertebræ, but in *Holbrookii* this part of the bladder is thicker, and is penetrated by a small bone on each side anteriorly, and firmly united to the processes of the fourth vertebra. The shape of the air-bladder is given in the accompanying figures; *a*, representing the surface that lies along the vertebral column; *b*, as seen from the under side; and *c*, giving the profile. The air-bladder is without a posterior foramen, and in this respect, as well as in its being more elongated than those having the foramen, the species is more closely allied to *O. barbatum*, *Broussonetii* and *brevibarbe.*



The *O. brasiliense*, with which the species should be compared, is said to have only the dorsal fin edged with black, and very short barbels. The air-bladder of this species is not known.

The teeth on the jaws are about the same in all the species of the genus I have examined, but there is a slight variation in those of the palatines, and more especially of the vomer, *O. Holbrookii* having a considerably less number of the rounded vomerine teeth than any of the other species mentioned below.

The following are the characteristics of the several species of the genus Ophidium which I have had an opportunity of examining. The species were first determined from their air-bladders by the aid of Müller's figures. I cannot refer any of the specimens to *O. barbatum* from the Mediterranean, and I have not seen *O. brevibarbe* and *O. brasiliense*, both from the Brazilian coasts.

O. Broussonetii Müller.

Inner barbel about two-thirds the length of the outer. Outer barbel equal to the distance from the centre of the eye to the point of the operculum. Maxillary reaching to the posterior margin of the eye. Length of the eye equal to the distance from its posterior margin to the ridge of the preoperculum. Head one-sixth of the total length of the fish. Dorsal and anal with a black margin. Gill-rakers four. Air-bladder long, oval, without a foramen.

Mediterranean.

Agassiz Collection. No. 2542. Mediterranean. (One specimen. 6 inches.)

Agassiz Collection. No. 4326. Nice, Prof. C. Gegenbaur. Received December, 1864. (One specimen. 6¼ inches.)

O. Holbrookii Putnam.

Inner barbel nearly two-thirds the length of the outer. Outer barbel equal to the distance from the centre of the eye to the point of the operculum. Maxillary reaching to the posterior margin of the eye. Length of the eye equal to the distance from its posterior margin to the ridge of the preoperculum. Head one-sixth of the total length of the fish. Dorsal and anal with a black margin. Gill-rakers four. Air-bladder long, pointed, without a foramen.

Gulf of Mexico.

Boston Society of Natural History. No. 1117. Key West, Florida, C. J. Maynard, 1872. (One specimen. 6 inches.)

O. marginatum DeKay.

Inner barbel not over one-half the length of the outer. Outer barbel about equal to the head in length. Maxillary hardly reaching to the posterior margin of the eye. Length of the eye very slightly more than the distance from its posterior margin to the ridge of the preoperculum. Head hardly one-sixth of the total length of the fish. Dorsal and anal with a black margin. Gill-rakers four or five (four on one side and five on the other of the single specimen examined). Air-bladder short and broad, with a foramen on the under side.

Atlantic coast of North America from New York southward.

Agassiz Collection. No. 2544. Charleston, S. C., Dr. J. E. Holbrook. (One specimen. 6¾ inches.)

O. Rochii Müller.

Inner barbel very nearly equal to the outer in length. Outer barbel fully equal to the head in length. Maxillary reaching considerably beyond the posterior margin of the eye. Length of the eye equal to about two-thirds of the space between its posterior margin and the ridge of the preoperculum. Head one-seventh of the total length of the fish. Dorsal and anal not margined with black. Gill-rakers four. Air-bladder pear-shaped, with a posterior foramen.

Mediterranean.

Agassiz Collection. No. 4327. Nice, Prof. C. Gegenbaur. Received December, 1864. (One specimen. 5½ inches.)

O. Vasalli Risso.

Inner barbel very nearly as long as the outer. Outer barbel fully equal to the head in length. Maxillary reaching considerably beyond the posterior margin of the eye. Length of the eye equal to about two-thirds of the space between its posterior margin and the ridge of the preoperculum. Head slightly more than one-seventh of the total length of the fish. Dorsal and anal not margined with black. Gill-rakers four. Air-bladder globular, with a posterior foramen.

Mediterranean.

Agassiz Collection. No. 4329. Mediterranean. (One specimen. 7 inches.)

Agassiz Collection. No. 4328. Nice, Prof. C. Gegenbaur. Received December, 1864. (One specimen. 6½ inches.)

FIERASFER.

For several years I have had in my possession eight specimens of the interesting genus of Fierasfer, which were given by Prof. Verrill from a number belonging to the Yale Museum, and collected at Panama by Mr. Bradley, in 1866. They were all obtained alive from pearl oysters, and fully prove the parasitical habits for which this genus of fishes is noted.[1] These specimens show so great a variation in their dentition and relative length of the head to the body, as to convince me that some of the species now acknowledged will prove to be unworthy of specific rank. On comparing these Panama specimens with several from the Atlantic coasts, I could not find any character by which they could be separated, and I am forced to admit that our North American species, now for the first time recorded, is the same on both sides of the continent, making one more instance of the occurrence of the same species on the Atlantic and Pacific waters of the central portion of America.

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[1] In the Museum of Comparative Zoölogy there is one valve of a pearl oyster from Panama, in which a specimen of *Fierasfer dubius* is beautifully enclosed in a pearly covering deposited upon it by the oyster.

I regret that I have but a single specimen of the genus from other regions for comparison, as it is impossible to distinguish the American fish by description alone from the following species:

F. acus Kaup, from the Mediterranean and the Atlantic coast of Europe; *F. affinis* Günther, from unknown locality; and *F. caninus*, Günther, from unknown locality.

From the description and figures given by Richardson of his *Oxybeles Homei*, from the Island of Timor and Australia, I cannot distinguish any characters by which the American species can be separated, and if it were not that I have the opportunity of comparing them with a single specimen taken from a starfish collected at the Kingsmills Islands, I should be much inclined to consider the American fish the same as *F. Homei*. The Kingsmills specimen, however, has so much larger, more numerous and more crowded teeth on the jaws, and has the central vomerine teeth so much larger than in the American specimens, and also has the anus slightly forward of the root of the pectorals, while in the American specimens it is directly under them, and is also a more slender fish with dark cross bars, that I believe it to be distinct from the American species, and the same as the one described by Richardson. Dr. Günther, in his characters of *F. Homei*, states that the gill membranes leave one half of the isthmus uncovered; but the Kingsmills specimen agrees with the American specimens in having the membranes united forward of the isthmus, and leaving it entirely exposed.

Fierasfer dubius sp. nov.

Head from one-seventh to one-eighth of the total length. Depth of head about one-half of its length, width about one-third. Mouth extending slightly beyond the eye. With the exception of two to four teeth in the front of the upper jaw, which are larger than the rest in the jaw and equalling the largest teeth of the lower jaw in size, the teeth in the under jaw are larger than those in the upper. Vomer with from three to six large teeth forming a central row, of which two or three are always much larger than the rest. Pectorals about one-half the length of the head. Vent under the base of the pectorals. Dorsal fin low but distinct. Anal fin much more developed than the dorsal, with its longest rays about in the middle of the fish, where the depth of the fin is equal to about one-half the depth of the body. At this portion of the fin the distant joints of the rays can be distinctly seen with a good lens. A short line of mucous pores commences over the operculum and extends above the silvery patch on the side to under the commencement of the dorsal. Color, in spirits, uniform light brown, with a short silvery band made by confluent spots along the sides of the abdomen. Air-bladder extending the whole length of the abdominal cavity and slightly constricted behind.

8 specimens, $3\frac{1}{4}$ to $4\frac{1}{4}$ ins. in length.	From Pearl Oysters, collected in the Bay of Panama, by F. H. Bradley, 1866. From the Yale Museum, No. 545. (These specimens are now in the *Peabody Academy of Science*, and in the *Agassiz Collection.* No. 4331.)
1 specimen, $4\frac{3}{4}$ inches in length.	From a Holothurian collected at Key Bisquan, Florida, by Theodore Lyman, 1856. *Agassiz Collection.* No. 4332.
1 specimen, $3\frac{1}{2}$ inches.	From a large Holothurian collected at Tortugas, Florida, by G. Wurdemann, March 19, 1858. *Agassiz Collection.* No. 2547.
1 specimen, $5\frac{1}{4}$ inches.	Cape Florida, G. Wurdemann, 1857. *Agassiz Collection.* No. 2470.
1 specimen, 4 inches.	Tortugas, Florida. G. Wurdemann, March, 1858. *Agassiz Collection.* No. 2546.
1 specimen, $3\frac{3}{4}$ inches.	New Providence, Bahamas. F. G. Shaw. Received April 22, 1861. *Agassiz Collection.* No. 4333.
1 specimen, 3 inches.	Locality unknown. *Agassiz Collection.* No. 4334.

Fierasfer Homei Kaup.

Oxybelis Homei Rich. Voy. Ereb. and Terr. Fishes, p. 72, pl. 44, f. 7–18.

Fierasfer Homei Kaup. Apod. Fish., p. 158.

A specimen of Fierasfer taken from a starfish collected at the Kingsmills Islands is probably of this species.

The head is one-eighth of the total length, and its depth is a little more than one-half of its length. The depth of the body is less than one-half the length of the head. The pectorals are about one-half the length of the head. The gill membranes are united forward of the isthmus, leaving it uncovered. Vent slightly in advance of base of pectorals. Dorsal fin very low. Anal more developed than the dorsal. Teeth on the jaws large and crowded, several in the upper jaw larger than the rest in the same jaw. Vomer with a central group of four large teeth. The general color is greyish with distinct darker cross bars, and a silvery band of spots along the sides of the abdomen.

This fish is of a darker color, with distinct bars, and with larger teeth, than *F. dubius*, and with a more anterior position of the anus.

1 specimen, 3 inches long.	From a starfish collected at the Kingsmills Islands, South Pacific, by Andrew Garrett. *Agassiz Collection.* No. 4335.

ECHIODON.

Echiodon dentatus.

Fierasfer dentatus Cuv. Règne Anim.

Echiodon Drummondii Thomp. Proc. Zool. Soc., 1837, p. 55. Trans. Zool. Soc., II, p. 207, pl. 38.

Though the genus *Echiodon* was established by Thompson without the knowledge that the fish he founded it upon was the same as Cuvier's *Fierasfer dentatus*, I think the generic name should be adopted for this species, as the presence of a distinct caudal fin, and the peculiar dentition are characters of more than specific value.

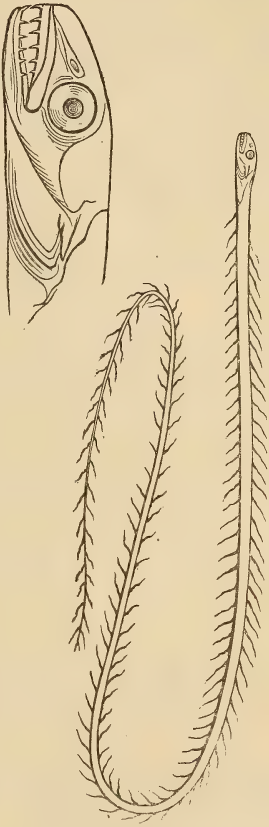
I have been unable to find the least indication of a caudal fin in *Fierasfer dubius* after careful microscopical examination, all the specimens showing the tail without caudal rays, and with the last dorsal and anal rays projecting beyond its fleshy end.

ENCHELIOPHIS.

In the year 1865 Dr. E. Haeckel sent to Professor Agassiz a very interesting collection of Mediterranean fishes. These specimens were all named except the single example which is the subject of these remarks, and though I can scarcely believe it possible that so distinct a form can have escaped the notice of all the many writers on the fishes of the Mediterranean, yet I must confess my inability to find any description that applies to it in the works at my disposal, and, in order to call attention to the form, I have ventured to place it in the genus proposed by Müller for the reception of a fish that may be characterized as Fierasfer without pectoral fins.

Of course there is a possibility of the fish now under consideration being well known to Mediterranean ichthyologists as the young of some one of the many species found there, though from the general character of the specimen I believe it to be a perfect, though perhaps not an adult, form.

The perfect development of the bones of the head, the distinct rays of the dorsal and anal fins, and the ossification of the caudal vertebræ, all give it the appearance of a perfect form, and its characters, so far as they can be traced without a dissection, which would destroy the specimen, shows the fish to belong to the family of Ophidiidæ, as defined by Günther.



The structure of the head, gill opening, position of the teeth on the jaws and on the vomer, and the position of the dorsal and anal fins, are similar to Fierasfer, but the body is not compressed as in that genus, being, on the contrary, nearly cylindrical, though the head is compressed and shaped much like Fierasfer.

The genus Encheliophis was proposed by Müller for the reception of a fish from the Philippines, which, if it were not from his statement that the pectoral fins were wanting, would be placed in the genus Fierasfer, and as the fish now under consideration has very similar characters,[1] and as I can find no trace of pectoral fins, I have referred it to the genus rather than risk the creation of a generic as well as a specific synonym.

Encheliophis tenuis sp. nov.

The outline figures here given representing the fish of natural size, and also the head enlarged, will serve to call attention to the form, and give the general characters of the fish.

The total length of the specimen is eight inches. Body naked, nearly cylindrical, slightly constricted back of the head, greatly elongated and terminating in a thread-like tail. Gill-openings wide, and as in

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[1] With the exception of the cylindrical body, and it may be that the strong spirits in which it has been preserved has much to do with its present shape.

Fierasfer. Teeth on jaws small but distinct. Vomerine teeth in a bunch with larger ones in the centre, as in Fierasfer. No pectorals, no ventrals. The dorsal fin commences posteriorly to the anal. The anal fin commences immediately after the short abdomen. Dorsal and anal rays very delicate,[1] but distinct and wide apart, extending along the thread-like tail. No membrane can be traced connecting the rays, though one probably existed in life. The upper angle of the operculum is produced as a minute and delicate spine. The height of the head is about equal to one-half of its length, and its length is contained thirty-four times in the total length of the fish. The diameter of the eye is equal to about one-fourth the length of the head, and is greater than the interorbital space.

Agassiz Collection. No. 4330. Mediterranean, at Messina, Dr. E. Haeckel, 1865.

NOTE ON THE NESTING AND EGGS OF LAGOPUS LEUCURUS.

BY DR. T. M. BREWER.

I have recently received the fragments of a set of eggs of the white-tailed Ptarmigan, *Lagopus leucurus*, and some interesting notes in relation to its breeding habits, from T. Martin Trippe, Esq., the well known ornithologist. Fortunately one of the eggs, though broken into a dozen fragments, admitted of being put together sufficiently to give the exact size, shape, and all the peculiarities of the egg. This egg is 1.70 inches in length, by 1.21 inches in breadth, is oval in shape, one end being but very little smaller than the other. The ground color is a rich creamy drab, and the surface of the egg is pretty uniformly marked with small rounded dots of dark chestnut. These are about equally distributed over the entire egg, and are nowhere confluent. The egg procured by Mr. J. A. Allen, and described in the North American Birds, is without doubt correctly identified, and the estimate of its length only varies from this specimen a tenth of an inch, the breadth being the same in both. Mr. Trippe writes me: "The eggs were found June 28, 1873, on a high ridge a thousand feet above the timber line, near the Chicago lakes, about fifteen miles from Idaho Springs. The nest was merely a slight depression in the ground, lined with a few white feathers from the mother's breast, which was quite bare. The eggs were eight in number, and the bird had evidently just begun incubating. She was so tame that I sat down on the grass by her side and lifted her off the nest, while she scolded and picked at my hands like a setting hen, I subsequently found several broods of young ones in July, August and September, from which I drew the following conclusions — that there are rarely more than ten in a brood, and usually from seven to nine. The young birds appear about the 10th of July; by the first or second week of August they are as large as quails, and their tails begin to show some white, and a few white specks to appear here and there. By the latter part of September they are nearly full grown. and very closely resemble the parent birds. When quite young they are striped with broad bands of blackish brown and dirty white, like some varieties of game and Cochin chickens. The mother is very assiduous in the protection of her brood, and employs all the little artifices that the Ruffed-grouse uses to draw off an intruder.

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[1] The woodcut represents the rays very much thicker than in the specimen.

I am under the impression that they raise but one brood a year, although I cannot be certain of this. Most of the brood are two-thirds grown, and strong on the wing by the 5th or 10th of September, but occasionally a young brood may be met with at that time, less than half grown. I am inclined to think, however, that in this case the first brood has been destroyed by hawks, weasels, or other predacious animals.

Section of Entomology. March 25, 1874.

Mr. E. P. Austin in the chair. Thirteen persons present.

The following paper was read.—

THE ODONATE FAUNA OF GEORGIA, FROM ORIGINAL DRAWINGS NOW IN POSSESSION OF DR. J. LECONTE, AND IN THE BRITISH MUSEUM. BY DR. H. HAGEN.

The materials for this sketch of the Odonata Fauna of Georgia came together gradually, and at great intervals of time. In 1852 Professor Heer placed in my hands a number of Odonata from Georgia, collected by Abbot, and belonging to the collection of the late Mr. Escher Zollikofer in Zurich, Switzerland, the duplicates of which I was allowed to keep for my collection. In 1857 I studied carefully a number of species collected by Abbot contained in the British Museum in London, and the original drawings in the library of that

Institution. I published in 1863, in the Stett. Ent. Zeit., T. XXIV, p. 369–378, a paper on the Neuroptera of Georgia. A considerable number of colored drawings made by the late Major J. E. LeConte (a few of them, however, may be by Abbot), now in possession of Dr. John L. LeConte, induced me to attempt again a sketch of the Odonata Fauna of Georgia, and I was courteously allowed by Dr. LeConte to examine the drawings in his possession. They are remarkably fine for details and execution; indeed they are so exact that I was able directly to recognize by the reticulation of the wings, and the arrangement of the veins in the triangle, a genus which I had never seen from North America before, and of which only a short time ago a species was described from Oregon by the Baron De Selys Longchamps. As I had the pleasure since to receive from Mr. Uhler a specimen from Georgia, the verification of this interesting drawing was confirmed in the most doubtless manner. I believe this drawing is a test for the degree of confidence we can give to all the others.

Family ÆSCHNINA.

1. **Anax Junius.** Male No. 61, LeConte; male No. 4, fem. No. 6, Br. Mus. April 15, ♂, March 23, ♀. Flies swiftly, not common. (The notes given always from the copy in the Br. Mus.)

2. **Anax longipes.**

This species is not figured by Abbot, but was described by myself from a female in the collection of Mr. Escher Zollikofer in Zurich, Switzerland, sent to him from Abbot. I should remark that I find this statement repeated in the Synopsis of N. American Neuroptera, in my manuscript description, but not in the catalogue manuscript I composed at the same time, of all species communicated to me by Mr. Escher Zollikofer. This species has been newly rediscovered as Mr. M'Lachlan told me, and is a very distinct species.

3. **Æschna Abboti** spec. nov. Hagen, Stett. Ent. Zeit., XXIV, 373, 55. Female No. 1, Br. Mus., May 12. Common also in summer and autumn.

Eyes of the female sky-blue, of the male green; front above green, with a black T spot; eyes behind black spotted with yellow; dorsum of the thorax green, with a brown stripe each side; sides brown; feet brown; abdomen green; first segment with a large dorsal brown spot, second segment with a large basal quadrangular brown spot, split behind by a green line; each side in the middle of the spot a small triangular green spot; segments three to eight, with similar brown spots, smaller on segments six to eight; ninth segment each side with an apical green spot; tenth segment brown; appendages very short, rhomboidal, broad; wings with a yellowish green tinge; pterostigma small, narrow, rufous; membranule grey.

Length 90 mill.; alar exp. 130 mill.; pterostigma 5½ mill; append. 2 mill.

The description is made from Mr. Abbot's drawing, which is well finished, together with some notes by Mr. Abbot on the foot of the sheet. The description given by me in the Stett. Zeit., is incorrect in several places, and carefully revised again from my notes and a diagram of the pattern of the abdomen. The very short rhomboidal appendages are very unusual, and induced me chiefly to describe this species only represented by a drawing. The dimensions are very large, and taken from the figure; they are doubtless of the natural size, as all other figures by Mr. Abbot. The supposition that perhaps the appendages are figured from a broken specimen seemed to be inadmissible, as the species is stated to be common through the greater part of the year. Perhaps *Æ. Abboti* belongs as female to the supposed male of *Æ. virens*, the female of this species not being well known.

4. **Æschna heros.** Female No. 59, LeConte.

The eyes are blue.

5. **Æschna virens.** Male No. 58, LeConte.

This figure is very interesting; Mr. Uhler supposed it to represent *Æ. clepsydra*, but the size is much too large, and the pattern of the color different. The membranule in *Æ. clepsydra* is darker on the anal margin, in the figure darker on the opposite margin. I am almost sure that Abbot's species is *Æ. virens*, but this species is not yet represented in any collection from Georgia. I possess them from Venezuela, Panama, Cuba, and perhaps from Florida. Their occurrence in Georgia would not be exceptional, as several southern species have a similar distribution.

6. **Æschna quadriguttata.** Male No. 12, Br. Mus., Mar. 22. Not very common.

7. **Æschna furcillata** Say. Male No. 51, LeConte.

The shape of the abdomen of the male with the third segment very much contracted, and the inferior appendage widely emarginate down to the middle, induce me to identify Abbot's figure with this species, not before known from the Southern States. All specimens known are from near Boston, Mass., except one female from Detroit, Mich. There would be no doubt at all, if I had not discovered a single pair of a nearly related species from Druid Hill, a locality near Baltimore, Md., *Æ. Antilope* Hag. A single female, the locality of which is not known, in my collection, communicated to me long ago, belongs to the same species. In *Æ. Antilope* the abdomen is not so much contracted in the third segment, the inferior appendage not so widely emarginated, the superior ones nearly straight, the number of post-cubital veins less (four instead of six). The female figured by Abbot has a yellowish tinge around the nodus, wanting in the three females of *Æ. furcillata* I have seen. The descriptions of *Æ. furcillata* are imperfect, and made from only two males.

Æschna furcillata Say, Journ. Acad. Philad., VIII, 15, 7; Edit. LeConte, I, 391, 7. Hagen, Syn. N. Amer. Neur., 131, 25; Proc. Bost. Soc. Nat. Hist., 1873, 272, 33.— *Gynacantha quadrifida* Rbr. Neur., 209, 1.

Male, eyes green (Abbot); labium dull luteous, the margin brown, a deeply impressed middle line black; the lateral lobes brownish in the middle; labrum dull luteous, the anterior margin black, emarginate in the middle; front dull luteous, above with a black T-shaped spot, large, triangularly dilated at the base, sloping down a little on the sides of the front; antennæ black; vertex inflated, dull luteous, darker on top, with black hairs; occiput dark, a little excavated before, with black hairs; eyes behind black, sinuated posteriorly; dorsum of the thorax brown, villous with brown, on each side an elongated quadrangular band, somewhat oblique, and smaller transversal one above it near the wings, both green; more outside, near the black humeral line, an elongated spot and a smaller one above, also green; dorsal carina black, elevated; the sinus brown; the sides of the thorax greenish, with two oblique black bands, the anterior broad, its superior third suddenly narrowed; the posterior on the suture, somewhat irregular, both connected beneath, and also with the humeral line; thorax beneath brown with large black lateral spots; axillary callus of the wings green; abdomen cylindrical, thin, the base inflated, the third segment very much contracted; abdomen dark brown, segments three to eight, with a double spot at tip, a smaller double on the middle, and a triangular spot at base; all spots green (Abbot); on second segment the spots are larger, and a small double spot more between the apical ones (Abbot); segment nine with a larger double spot at tip; segment ten dark brown; segments one and two with larger yellowish spots besides; segments three to eight with an obscure (green?) spot each side; abdomen beneath brown; earlets rounded, flattened, with a double series of small black spines on the border; apical margin of the last segment rounded, with excavation before the tip; superior appendages as long as the two last segments together, black, ciliated inside, narrow, foliaceous, curved inwards and downwards; the square between them ovoid; basal third narrower, cylindrical, with two small inferior teeth, one before the middle, the other at the end of the basal third; beyond the middle rectilinear, flattened, sides parallel, rounded at tip; inferior appendage black, about half as long, widely emarginated down to its middle, the two parts narrow, sharp, curved upwards a little; anterior piece bifid, forming two strong spines; anterior hooks ovoid, large, with a basal interior elevation; posterior hooks cylindrical, recurved on tip; sheath of the penis black, deeply excavated, with two lateral strong erect horns, flattened and strongly incurved; feet long, thin, black, femora rufous above, tibiæ with moderate spines; wings hyaline, with a very slight yellow basal tinge on all wings, veins black, the costa and the transversal veins near the costal margin to the nodus yellow; membranule whitish grey; pterostigma short rhomboid, broad, rufous, covering one and one-half areolets; thirteen antecubitals, seven postcubitals on the anterior wings; eight antecubitals, seven postcubitals on the hind wings; triangle with one transversal vein, two series of discoidals; areolets in the wing rather large; nodal sector single; anal angle of the hind wings marked; one transversal in the anal triangle.

Length of the body without app. 53 mill.; abdomen 38; super. app. 5; pterostigma 2; poster. femur 9; alar. exp. 72; head 8.

Female. Head, thorax, legs and wings similar to the male; abdomen more inflated on the base, the third and the following equally contracted, the following ones thicker, spotted just as the male; in Abbot's figure the spots are larger, greenish white, except the basal ones on the second segment, which are yellowish green, as in the male; the eyes are figured darker, brownish, the spots on the thorax also darker; last segment short, cut straight; the appendages as long as the last segment, black, short, flat, straight, rounded on tip; vulvar-hames short, black, with two long black palpi; last segment beneath produced, covered with spines; twelve to thirteen antecubitals; six to seven postcubitals on the anterior wings.

Length of the body 50–54 mill.; abdomen 34–38; append. 1½; alar. exp. 66–70.

Hab. One male in the Harris Collection, the type of Say, from Massachusetts, and another from Sutton, Mass., June 15, 1865; the male type of Rambur in De Selys' collection; one male from Milton, Mass., in the Museum collection; a female from Brookline, Mass., June 8, 1864, in the Museum of the Society of Natural History, and three in the Museum collection, two from Massachusetts, and one from the Detroit River, Mich., where according to H. G. Hubbard, the species is common in August. Finally Georgia from Abbot's drawings. This species is a very rare one in collections; De Selys forms for it his genus Gomphæschna.

A number of nymphæ from the Detroit River belonging, as Mr. Hubbard presumes, to this species, have a very peculiar appearance by their variegated coloration. The general color is dark gray, but the two basal and the eighth segment of the abdomen are pale whitish.

8. Æschna Antilope spec. nov. Female, No. 51, LeConte.

This species is very similar to *Æ. furcillata*, but differs as follows:—

Male.
1. The labium is entirely luteus.
2. The head is more orbicular, the eyes less flattened above.
3. The vertex is yellow on each side.
4. The dark bands on the sides of the thorax are less developed; the first is brown, narrower, abbreviated, the superior half wanting; the second one is blackish, but narrower; the thorax below has only black lines instead of black spots.
5. The femora bright rufous throughout.
6. The abdomen is more inflated, ovoid at base, the third segment less contracted, and the abdomen gradually tapering from the contraction, much narrower on tip.
7. The pattern of the coloration similar, but the apical spots on the segments larger, quadrangular; the last segment even with large spots on sides.
8. The last segment much more impressed on tip, and in the middle a well developed crista, only indicated in *Æ. furcillata.*
9. The superior appendages of the same shape and length, but straight, not bent down or inwards; the inferior appendage much narrower, the two branches with an apical distance of a little more than one millim. (two and one half in *Æ. furcillata*). The genital parts in

the second segment of the abdomen similar, but not sufficiently visible, for certainty.

10. Costa of the wings more largely yellow, base of the wings without any yellow tinge; pterostigma luteous; only four postcubitals in the anterior, five to six in the hind wings; twelve antecubitals in the anterior, seven in the hind wings; anal triangle without transversal vein.

Female. Head similar to the male; the color of the dorsum of the thorax obliterated, but there are the larger spots indicated; the thorax of an uniform pale brown color; the black bands on the sides less marked; feet as in the male; the shape of the abdomen compared with the female of *Æ. furcillata* is less dilated, not so ovoid at the base; the segments seven and eight more dilated; the pattern of the coloration similar, but developed in a different manner; on segments two to seven the basal spots wanting, the four others after the transversal line large and quadrangular; the middle ones separated only by the longitudinal dorsal line, the apicals contiguous on the apical margin, a little wider separated before by brown; segment eight with all spots nearly confluent, only a small basal blackish transversal band; segments nine and ten colors obliterated, nearly pale throughout; segments two and three with a very small basal yellow spot on the middle; all the other spots somewhat luteous; sides of the abdomen, the part beneath, and the venter, largely luteous; vulvar laminæ luteous, palpi blackish, the seta brown; wings similar to the male, but a marked dark luteous tinge around the nodus; anterior wings with nine to ten antecubitals, and three to five postcubitals; hind wings with six antecubitals and four to five postcubitals. All the areolets in the wings larger than in *Æ. furcillata.*

The dimensions of both male and female are the same as in *Æ. furcillata.*

The drawing of Abbot agrees very well with the spots of the abdomen, thorax and head, and the yellow tinge around the nodus; the areolets are, however, given larger than in the male of *Æ. furcillata*, and has antecubitals.

Hab. Druid Hill, near Baltimore, Md., by Mr. Uhler, one male and one female in very bad condition, probably from the same locality. One female in my collection without any locality, even the most general, from a merchant in Europe.

9. Æschna janata? No. 26. Brit. Mus., male, March 26, rare.

I gave this determination as doubtful, Stett. Zeit., XXIV, 373, as there exists no specimen of this very rare species in European collections. Even now I have only seen two pairs, both from Massachusetts. My determination was made from Say's description, and a new comparison is necessary.

Family CORDULEGASTERINA.

10. Cordulegaster Sayi. Male, No. 9. Brit. Mus., March 30, near Ogechee River, not common.

I have not yet seen specimens from Georgia, besides the typical pair from Abbot in the British Museum. I have also seen one pair from Maryland; also males from Connecticut, Massachusetts, New Hampshire, White Mts., where this species is more common, and Port Neuf in Canada. The northern specimens are smaller and darker.

11. Cordulegaster maculatus. Female, No. 8. Brit. Mus., March 20, rare.

I have seen a female type from Abbot in the Brit. Museum, one female from Maryland and one from the United States in my collection, a male, probably from New England, in Harris' collection, and a male from Woburn, Mass. The species seems to be rare.

12. Cordulegaster obliquus.

I possess a male from Abbot, and I saw two smaller ones from Connecticut and Orono, Me., in Dr. Packard's collection. The female has been taken in Rock Island, Ill., according to manuscript statements by the late B. D. Walsh. The full comparative descriptions of these species are retained for another paper.

Family GOMPHINA.

13. Progomphus borealis. DeSelys, Trois. Addit. au Synopsis de Gomphines, 1873, 36. Male, female, No. 52, LeConte.

The discovery of this genus, hitherto not represented in the fauna of North America, is very interesting. The only male described by De Selys is from Oregon, and I have not seen it, but the description agrees; nevertheless, as the specific differences of the Progomphus species are rather obscure, and as the two localities, Oregon and Georgia, are very distant, perhaps the species from the latter State may prove distinct. All I can say now, is that I am unable to find differences between *P. borealis* and Abbot's species. It is worthy of notice, that Mr. Cabot in his monograph of the immature state of the Gomphina, p. 6, has described some nymphæ from Wareham, Mass., supposed to belong to a species of Progomphus.

Male. The description is made from a male from Georgia in Mr. J. Riding's collection.

Head pale yellow; an obliterated darker transversal band on the front, near the epistoma; rhinarium and an ill-defined middle part of the epistoma obscure; a transversal brown band above on the front, just before the ocelli, the middle part of it rounded, produced without reaching the anterior margin of the front; antennæ dark brown, the tip of the three basal joints palely annulated; space between the eyes dark brown; vertex broad, short, deeply excavated in the middle, yellow, the sides and front margin brown; occiput yellow, ciliated behind with pale hairs, broad, the border rather sharp, slightly emarginated, darker on the sides; eyes behind brown, each side near the margin two inferior yellow spots; thorax brown, the dorsum with an anterior transversal band connected with an oblique band, both yellow and converging, not reaching the sinus; farther outwards an inferior yellow humeral line and a yellow superior spot; crista of the thorax yellow to its bifurcation; sides of the thorax brown, with two ill-defined oblique yellow bands; beneath pale brown, behind the posterior feet a larger blackish spot each side; abdomen slender, cylindrical, the base and the last segments enlarged; segments two to seven with a dorsal spear-shaped fascia, reaching the apical margin in two and three, gradually shorter in the others; segments one to three largely yellow, the following much less so; segments seven and eight each side with an inferior yellow middle spot; venter black; earlets compressed, yellow, the band rounded; last segment half as long as the penultimate; apical margin rather recurved, cut straight in the middle of the margin, more obliquely above the appendages; superior appendages yellow, a little darker at base, nearly twice as long as the last segment, broad, flat, the apex rounded inside, curved slightly outwards, ending in a sharp black point; inferior appendages black, shorter, cylindrical, stronger to the inwardly bent fusiform tip, with two superior small teeth just before tip; outside somewhat before, a short black tooth; genital parts on the venter of the abdomen with a short erect luteous middle spine; first hooks not visible (perhaps not existing), second hooks large, yellow, tapering to the strongly inwardly bent black, sharp tip; sheath large, erect, orbicular, hollowed inside, darker on the border, which is notched in the middle; bands of the second segment enlarged in the apical half and rather excavated; feet short, black, anterior femora beneath bright yellow, the others brownish; extreme base of tibiæ yellow; trochanter rufous; wings hyaline, extreme base dark brown, forming a short brown band to the first antecubital vein in the second space; veins blackish; costa yellow to the pterostigma, which is large, oblong, blackish rufous, covering five areolets; membranule rudimentary, whitish; anal angle prominent; fifteen to sixteen antecubitals, nine postcubitals in the anterior wings; twelve antecubitals, ten postcubitals in the hind wings; triangle in anterior wings with three transversals, united in the middle, in hind wings with one or two parallel to the interior side; interior triangles with one transversal vein; two series of discoidals, commencing with three.

Length without app. 47 mill.; abdomen 34 mill.; super. append. 2½ mill.; pterostigma 4 mill.; alar exp. 68 mill.

Abbot's figure has the body 53 mill. long, all yellow, very bright; otherwise it agrees very well, even in the details of neuration.

The differences of De Selys' *P. borealis* are as follows: the basal dark band on the wings is a little shorter; twelve postcubitals of the anterior wings; the abdomen long, 41 mill., just as in Abbot's figure; the segments eight to ten, with yellow spots; feet not so dark. A diagram of the appendages, kindly sent by Mr. M'Lachlan, does not show the two superior small teeth before the tip of the inferior appendage; otherwise they are not different.

Female according to Abbot's figure similar to the male in colors and shape; the abdomen not so slender in the middle, the yellow fasciæ on segments two to seven larger, the tips broad, reaching the apical margin; appendages yellow.

Hab. Georgia, one male and Abbot's drawings.

14. **Gomphus pallidus.** Male, No. 54; female, No. 55, LeConte.

I possess a type specimen of the female from Abbot, agreeing with the figure, and I have no doubt that the male belongs to it, as I compared one long ago sent by Abbot to Escher Zollikofer. Nevertheless this male I believe to be identical with one in my collection from New Orleans, which is the type of my *G. pilipes*. I possess, even now, no more material to decide the question. This species seems to be rare.

15. Gomphus pilipes, quoted by me Stett. Zeit., XXIV, 373, belongs to the male in Escher's collection in Zurich, and is perhaps doubtful.

16. Gomphus spinosus. Male No. 11. Brit. Mus., June 6. Very common.

I saw a type specimen from Abbot in Mr. Escher's collection.

17. Gomphus dilatatus. Male No. 14. Brit. Mus., May 24. Not very common.

I possess a male type from Abbot.

18. G. minutus. Female No. 21. Brit. Mus., March 29. Common. Male, No. 53, LeConte.

I possess a male type from Abbot, described in the monograph.

Family CORDULINA.

19. Macromia tæniolata. Male, No. 2. Brit. Mus. Flies mostly in the evening, not very common, June 20. Male, No. 60. LeConte. In Synops. Cordulines, p. 91.

De Selys supposes the male in my collection with the anterior triangles without any transversal vein an anomaly, but Abbot's figure, otherwise correct for the details of neuration, represents the triangles also without transversal vein. The eyes are bright green, the spots sulphur yellow. The species seems to be very rare, at least not represented in American collections.

20. Macromia transversa. Male, No. 53; female, No. 54, LeConte; female, No. 10, Brit. Mus., March 27. I have seen a female sent by Abbot to Mr. Escher Zollikofer.

There was no male in European collections, and the description of the male was taken from Say's paper. This species is widely distributed. I have seen it from Vermont, Massachusetts, New York, Pennsylvania, Washington, South Carolina, Georgia, and nymphæ, which I am unable to separate from the typical ones, from Detroit, Michigan. The abdomen has elongated yellow dorsal bands on segments two to seven.

21. Epitheca princeps. Female, No. 3. Brit. Mus., May 7. Flies very high and swift, and is difficult to take; the eye of the male is green; rare.

Abbot's figure is very large (length 84 mill.; alar exp. 123 mill.), perhaps somewhat magnified. The largest specimen I have seen is a male from Georgia, communicated by Abbot to Mr. Escher Zollikofer, (length 72 mill.; alar exp. 102 mill.). I have seen the species from De Plaines River, Ill. (Walsh), a very large male from New Haven, Conn. (S. I. Smith), Maryland, Georgia and Pecos River, Western Texas. De Selys has placed the species in the genus Cordulia.

22. **Epitheca filosa.**

I possess a male from Georgia communicated by Abbot to Mr. Escher Zollikofer. I have seen specimens from New Jersey and Charles Co., Md., August 6–8, Uhler.

23. **Epitheca linearis.** Male, female, No. 57. LeConte.

Of this species I have seen only two males from St. Louis, Mo., and Northern Illinois, and a female in bad condition from Pennsylvania (Uhler). I have no doubt that the figures by Abbot belong to this species. The eyes and front of the male are green, the vertex rufous; the body seems to be rufous brown, the dorsum of the thorax green; a basal lateral yellow spot on segments five to six. The female is colored rufous brown, the appendices long ($3\frac{1}{2}$ mill.), slender, of the same color, wings as in the male. The dimensions similar.

24. **Cordulia** sp. nov. Male, No. 20. Brit. Mus., March 29. Rare.

The figure resembles *C. cynosura* Say, but the anterior margin of the wings is brown, the base without a darker spot; alar exp. 70 mill. Apparently an undescribed species.

25. **Cordulia cynosura** (*lateralis* Burm.). Female, No. 20. Brit. Mus., March 6. Not very common.

I have seen specimens from Massachusetts, Illinois, Ohio, Pennsylvania, Louisiana, Florida.

26. **Cordulia semiaquaca.** No. 22. Brit. Mus., March 19 Not common. No. 44, male, female, LeConte.

I have seen a typical specimen from Abbot in the collection of Mr. Escher Zollikofer. I have seen this species from Massachusetts, New York, Washington, South Carolina, Georgia, Florida. In Abbot's figures the eyes are brown; and the lateral yellow spots of the abdomen very bright.

Family LIBELLULINA.

27. **Tetragoneuria costalis.**

The typical specimen is in De Selys' collection.

28. **Pantala flavescens.** No. 76. Brit. Mus., July 8. Common.

This species is spread over nearly the whole world; in the United States Maryland is the northern limit.

29. **Tramea Carolina.** Male, female, No. 50, LeConte.

I have seen a typical specimen sent by Abbot to Mr. Escher Zollikofer. The northern limit for this species is New York.

30. **Celithemis Eponina.** No. 27. Brit. Mus., August 7. Rare. Male, No. 42, LeConte.

I have seen a typical specimen sent by Abbot to Mr. Escher Zollikofer. Massachusetts and the lakes are the northern limit for this species.

31. **Plathemis trimaculata.** Female with brown, and male with pruinose abdomen. No. 79, No. 80, female No. 78. Brit. Mus., July 18. Common.

I saw typical specimens of all different forms communicated by Abbot to Mr. Escher Zollikofer.

32. **Libellula semifasciata.** Male, No. 77. April 2, June 29. Not very common. Brit. Mus. No. 41, male, female, LeConte.

I possess a female type from Abbot.

33. **Libellula pulchella.** Male, No. 43, LeConte; No. 3, male with pruinose abdomen. Brit. Mus., Sept. 8. It is the rarest of all the Libellulæ.

The last statement is somewhat remarkable as indicating the southern limit for this widely distributed species. I possess specimens from Frederic Co., and Baltimore (Uhler), Md., from Pennsylvania, New Jersey, New York, Massachusetts, New Hampshire, Maine; from the Western States I have specimens from Chicago and Rock Island, Ill., from Dallas and Ware, Texas; from Ogden, Utah, and Mr. Uhler has stated the occurrence in Mississippi. Only the southeastern part of the Western States is not represented in the distribution of this species.

34. **Libellula deplanata.**

I possess a specimen from Abbot; see Proc. Bost. Soc. Nat. Hist., xv, 265.

35. **Libellula auripennis.** Male, No. 16. Brit. Mus., April 20. Common. Male, female, No. 45, LeConte.

I possess a type from Abbot.

36. **Libellula Lydia.** Male, No. 5; female, No. 7. Brit. Mus., April 20. Rare.

I possess a male and female from Abbot.

37. **Libellula Axillena.** Male, female, No. 46; male, adult, No. 47, LeConte.

I have strong doubts about the difference of *L. Lydia* and *L. Axil-*

lena. *L. Lydia* is always larger, the tip of wings more colored; I have seen it from Louisiana, Texas, Georgia, South Carolina, Florida. Of *L. Axillena* I possess a typical male from Abbot, from Louisiana or Florida. The specimen from Georgia, agreeing very well with the figure No. 47, is the smallest I ever saw, but I am not yet able to find any sure specific difference.

38. Libellula incesta. Male, No. 55, female, No. 47, LeConte.

These drawings of Abbot, both male and female, have been identified as *L. plumbea*, by Mr. Uhler, the first describer of this species, I only know *L. plumbea* from a male kindly communicated by himself, and I have never seen the female. To contradict the founder of the species would seem rather hazardous, nevertheless as the figures do not agree with the description given by Mr. Uhler, I believe I am correct. *L. plumbea* is of smaller size, the wings with a ferrugineous tinge upon the costal margin and on the tip of the female. *L. incesta* is a rare species in collections. I possess the male from South Carolina and Dallas, Texas, and two of uncertain locality, one of them, probably erroneously, marked Massachusetts. The male agrees very well with Abbot's figure. According to Abbot's figure the female is the size of the male, brown, thorax with a large bright yellow band between the wings, commencing at the abdomen and tapering on the dorsum of the thorax to the prothorax; abdomen bright yellow, with a large dorsal fuscous band, not reaching the first segment; segment eight to nine, brown; the sutures of all segments and the lateral margin finely brown; appendages short, dark brown; feet brown; wings exactly as in the male, hyaline, the costal margin from the pterostigma to the tip infuscated; pterostigma black, long.

39. Libellula plumbea. Female, No. 17. April 27. Common. Brit. Mus.

I gave this statement Stett. Zeit., XXIV, p. 375. I do not know that my determination is correct.

40. Lepthemis hæmatogastra.

I saw one male in the collection of Mr. Escher Zollikofer, communicated to him by Abbot.

41. Mesothemis simplicicollis. A teneral male, No. 18. Brit. Mus., April 25, June 15. Brit. Mus., male, female, No. 49, LeConte.

I have seen a type from Abbot, and possess specimens from Georgia. The species is common nearly everywhere east of the Rocky Mountains, also in Mexico and Cuba.

42. Mesothemis longipennis. Male, No. 23, female, No. 24. Brit. Mus., May 23. Not very common. Male, female, adult, both pruinose. No. 40, male, female, No. 56. LeConte.

I have seen a type from Abbot in Mr. Escher Zollikofer's collections, and I possess specimens from Georgia, and numerous other localities. This species is even as common and widely distributed as the foregoing one.

43. Diplax albifrons. Male; female, No. 81. Brit. Mus., September 1; male; female, No. 48. LeConte.

These drawings of Abbot are not so well finished as of the other species, and not sufficiently so for a sure determination. I believe them to represent *D. albifrons*, chiefly because I have seen a type of this species from Abbot.

44. Diplax elisa. No. 22. Brit. Mus. June 9. Rare.

45. Diplax amanda. Male, No. 29, female, No. 30. Brit. Mus., March 29, April 20. Common. Male; female, No. 39. LeConte.

I possess a female from Georgia, but have never seen a male, which according to Abbot's drawing, is exactly similar to the female in size and color; the appendages are yellow.

46. Diplax ornata. Male, No. 39. LeConte.

I possess this species from Pennsylvania and Florida.

47. Diplax minuscula. Male, female teneral and male, female adult pruinose, No. 38. LeConte.

I have seen this species from Georgia; it is quite an interesting fact that the adult female becomes also pruinose.

48. Perithemis Domitia var. *chlora*. Male, female, No. 18. Brit. Mus., June 21. Frequent near Savannah River, Burke Co., not a common sort.

49. Nannophya bella. Male, female, No. 82. Brit. Mus., April 20. Very frequent.

I have seen this widely spread species from different localities.

50. Nannophya maculosa.

I have seen only two males from Abbot in Mr. Escher Zollikofer's collection.

Family CALOPTERYGINA.

51. Calopteryx angustipennis. Male, No. 19. Brit. Mus., April 18. Briar Creek, rare.

I saw in the British Museum a male sent by Mr. Abbot; a female is in my collection. There are no other specimens known of this rare and interesting species.

52. Calopteryx dimidiata. Female, No. 26. Brit. Mus., April 25. Not common.

I saw a male and female sent by Abbot to Mr. Escher Zollikofer.

53. Calopteryx maculata. Male, No. 25. Brit. Mus., April 16. Common. Male, female, No. 65. LeConte.

I saw a specimen sent by Abbot to Mr. Escher Zollikofer.

54. Hetærina septentrionalis.

A male sent by Abbot is in the British Museum.

55. Hetærina tricolor. Male, No. 30. Brit. Mus.

I have seen specimens from Georgia.

Family AGRIONINA.

56. Lestes rectangularis.

I saw specimens from Dalton, Georgia.

57. Lestes hamata (*L. forcipata*, Syn. N. Am. Neur.). Female, No. 63. LeConte.

I possess a female type from Abbot.

58. Lestes forcipata (*L. hamata*, Syn. N. Am. Neur.). Male, female, No. 62, LeConte.

This is only a supposition, the drawings are not sufficient for a sure determination.

59. Argia fumipennis. Male, female, No. 21. Brit. Mus., April 18. Common. Male, female, No. 64. LeConte.

60. Argia tibialis (*Agrion fontium*, Syn. N. Am. Neur.). Male, female, No. 63. LeConte.

I have seen a specimen from Abbot in Mr. Escher Zollikofer's collection.

61. Argia bipunctalata.

I saw a specimen sent by Abbot.

62. Agrion hastatum. Male, female, No. 22. Brit. Mus., April 26. Not very common. Male, No. 62, female and the orange var., No. 64. LeConte.

I saw specimens sent by Abbot to Mr. Escher Zollikofer.

63. Agrion positum. Male, No. 64. LeConte.

The figure is not sufficient for certainty. I saw this species from Georgia.

64. Agrion Ramburii.

I saw specimens from Georgia.

65. Agrion signatum. Male, female, No. 62. LeConte.

The figures are not sufficient for a sure determination, but as I possess a male sent by Abbot, the identity is probable.

66. Agrion spec. Male, No. 63. LeConte.

A determination is not possible; the species is a light blue one, similar to *A. civile* and *F. Doubledayi.*

There are of the above quoted sixty-six species, thirty-six species figured in the copy of the British Museum, and thirty-four in Mr. John LeConte's copy. Fifteen species only are represented in both copies, so that fifty-four species are figured by Abbot and LeConte, twenty-five in both sexes; twenty-one the male only, nine the female.

Mr. Scudder read a paper on the species of the Genus Pamphila, which will appear in the "Memoirs."

Mr. S. H. Scudder remarked that the Polar Expedition had brought home two specimens of butterflies, both the *Argynnis polaris.* They are probably the most northern specimens ever taken.

April 1, 1874.

The President in the chair. Forty-three persons present.

Profs. Kuppfer, Ganin, Kowalewsky, and Mr. J. T. Gardner, U. S. Geol. Survey, were elected Corresponding Members. Messrs. R. R. Andrews, Fr. Blanchard, B. S. Codman, M.D., H. T. Codman, H. Coleman, M.D., G. R. Crotch, E. P. Cutler, James Delano, Geo. Dimmock, Wm. W. Dodge, S. W. Garman, C. E. Hamlin, D. A. Hamlin, Chas. H. Higbee, Ernest Ingersoll, W. P. Lawrence, D. M. Little, Philip Little, H. K. Morrison, John Murdock, W. E. Norton, Henry A. Page, Chas. G. Weld, C. O. Whitman, Arthur E. Wilson and Chas. Wilson were elected Resident Members.

The following paper was read: —

REMARKS ON THE FAMILY NEMOPHIDÆ. BY F. W. PUTNAM.

In 1803, Russell, in his "Fishes of Coromandel," figured a fish on plate 39,[1] which Swainson in 1839 names *Xiphasia setifer*, but does not give any description, evidently knowing the fish only from the figure by Russell, though he referred it to his subfamily Ophidonidæ in which he also placed the genera Cepola and Nemotherus.

Dr. Kaup, in 1858, communicated a paper to the Zoological Society of London, in which he describes (accompanied by a figure) under the name of *Nemophis Lessoni*, two specimens of a fish in the Paris Museum. The locality whence these specimens, which were "nine Paris inches in length," were obtained was not known. Dr. Kaup states that the specimen he examined was in "poor condition," which will account for the supposed absence of the ventral fins, but he calls particular attention to the peculiar character of the large canine teeth, and states that the fish is so unlike the other "ribbon-shaped fishes," with which he confounds it, as to form a distinct family, for which he proposes the name of *Nemophidæ*.

Dr. Günther, in his third volume of the Catalogue of Fishes in the British Museum, published in 1861, places Kaup's genus Nemophis, which he knew only from Kaup's figure and description, in the family Blenniidæ, though he states that "the position of this singular fish cannot be exactly determined."

In the next volume of his Catalogue, published in 1862, Dr. Günther characterizes a genus under the name of *Xiphogadus*, based on the figure given on plate 39 of Russell, and places the genus in the group of Brotulina in the family Ophidiidæ. For this fish he adopts the specific name of *setifer*, and quotes Swainson's generic name of Xiphasia with an exclamation mark, probably intending thereby to indicate that the name is not admissible on account of its construction.

In 1864, Dr. Bleeker described under the name of *Xiphasia trachypareia*, a fish which Dr. Günther, in the Zoological Record for the same year, and under the heading of Blenniidæ, genus *Xiphogadus*, remarks on as follows: — "Dr. Bleeker has had the good fortune to rediscover the fish (or at least one closely allied to it) which was figured by Russell (i, pl. 33 [39]). It proves to be a Blennioid, near *Petroscirtes*. He considers it also possible that *Nemophis* of Kaup may be a fish allied to it. Dr. Bleeker prefers to adopt the name of *Xiphasia*(!)"

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[1] There is not a copy of Russell's work in any library in Boston, Cambridge or Salem, and as I have never seen the plate referred to, I know it only from the description given by Günther, who also states that the single specimen observed by Russell was fourteen inches in length, and was from Vizagapatam.

This paper by Dr. Bleeker is reprinted, with a plate representing the fish of natural size, in the publications of the Amsterdam Academy of the following year. The habitat of the specimen, which is about eighteen inches in length, is unknown.

In the Annals of the Lyceum of Natural History of New York, for 1865, Prof. Gill described and figured a new genus of fishes under the name of *Plagiotremus*, from a specimen five and one-half inches in length, collected by Dr. Stimpson in the China Sea. From the description given, it is evident that this fish is closely allied to *Nemophis* of Kaup, as Prof. Gill states, and he therefore places it as a subfamily of the family Nemophidæ. Prof. Gill also considers the family as allied to the Blennioids. He further mentions that in Mr. Brevoort's collection there is a species of *Nemophis* from Madagascar.

In the Zoological Record for 1865, Dr. Günther, in noting the genus *Plagiotremus* of Gill, which he refers to the Blenniidæ, makes the following statement: "Mr. Gill thinks that this remarkable fish should be united with *Nemophis* into a family *Nemophidæ*; but it would appear to the Recorder that it shows sufficient affinities to *Xiphogadus*, with which it should be compared."

The Proceedings of the Zoological Society for 1868, contains a paper by Lieut. Col. Playfair on a collection of fishes from Madagascar, in which is described as a new species, *Xiphogadus madagascariensis*, from a specimen eleven and one-half inches long, which was taken, in a partially digested condition, from the stomach of another fish caught in the Mouroundava River.

The final reference I have to make in this summary of the history of this family is the following quotation from Dr. Günther, as the Ichthyological Recorder of the Zoological Record for 1868, published in 1869, where under the family of Blenniidæ he gives the following paragraph: —

"*Nemophis.* The Recorder has recently had an opportunity of examining nine examples obtained in various parts of the Indian Ocean, and is convinced, 1, that *Xiphogadus* is identical with *Nemophis* of Kaup (who overlooked the ventral fins); and, 2, that although the examples examined by him may belong to two distinct species, differing only in the extent of the snout, there is no evidence to show that the fishes described by Rüppell [? Russell], Kaup, and Bleeker, are specifically distinct. He makes this observation on account of Col. Playfair having described as a fourth species a *Xiphogadus madagascariensis*, Proc. Zool. Soc., 1868, p. 11. Having examined the typical specimen (which is in a very bad state), the Recorder may add that it cannot be made the type of a distinct species."

To this history I have the opportunity of adding a few remarks and lines of description made after examining two small specimens contained in the Agassiz Collection, one of which was collected in the China Sea, and the other from an unknown locality.

It will, from the foregoing, be seen that the name of Xiphogadus must, as Dr. Günther himself admits, at least give way to Nemophis, and, if the strict law of priority is to be followed, that of Xiphasia, proposed by Swainson and adopted by Bleeker, must take precedence of both, and as it would add still further to the very great confusion in the names of fishes if every name not perfectly constructed is to be given up, I prefer, with Dr. Bleeker, to adopt the name proposed by Swainson.

That the family is allied to the Blenniidæ, especially to the genus Petroscirtes, is probable, but the very singular structure of the closely united intermaxillary and maxillary bones, the latter being the seat of the canine teeth when they are present, taken in connection with the elongated and scaleless body, the simple rays to the long dorsal and anal fins, with the rudimentary character and forward position, or entire absence of the ventral fins, indicate a well-marked family, as proposed by Dr. Kaup and adopted by Prof. Gill.

NEMOPHIDÆ.

Nemophidæ Kaup, 1858. *Nemophidæ*, subfamily *Plagiotrematinæ* Gill, 1865.

Body long, slender; abdominal portion short. Dorsal and anal fins long. Pectorals normal. Ventrals, when present, forward of the pectorals, and connected with the humeral arch. Branchiostegal membranes united, and leaving but a small gill-opening. Maxillaries closely united to the posterior edges of the intermaxillaries, and forming an even border to the mouth above.

XIPHASIA.

Xiphasia Swainson, 1839. *Nemophis* Kaup, 1858. *Xiphogadus* Günther, 1862.

Body greatly elongated, slightly compressed, scaleless. Fin rays simple. Dorsal commences over the eye, and is continuous to the caudal, with which it is united. Anal commences just back of the vent, and is continuous to the caudal with which it is united. Caudal of few rays. Ventrals reduced to three simple rays. Branchiostegal rays six; the inner ones small. Gill-opening small, and placed principally above the base of the pectoral fin. No pseudobranchia. Gills four, with an opening behind the last; gill-rakers not developed; lower pharyngeals small, narrow and separate, with very few, small, pointed teeth. Border of the mouth above formed by the intermaxillaries, maxillaries, and a fleshy portion behind. Intermaxillaries broad, short, and closely united to the wide and short maxillaries. A single row of distinct, pointed, flattened movable teeth on the intermaxillaries and in front of the under jaw. A firmly imbedded curved canine tooth in each maxillary. (On one side of one specimen there were two of these teeth, as represented in the figure of the bone.) A large fixed canine tooth on each side of the under jaw, which, when the mouth is closed, passes into a cavity under the line of union of the intermaxillary and maxillary. Vomer and palatines without teeth. Anterior nostril slightly tubular; posterior one near the upper margin of the eye. Four mucous pores on the head between the eyes. Bones of the head thin and membranous. Opercular bones very thin and closely united.

The dissection of the internal organs was not satisfactory, owing to the condition of the specimen, but showed a large liver extending over the intestines to about the centre of the abdominal cavity. The stomach was not distinguishable from the intestine, and formed with it three loops, followed by a short straight course to the anal opening. No pyloric appendages. Air-bladder? (if present very small and delicate). The peritoneal membrane silvery, and seen through the abdominal walls.

Xiphasia setifer.

Xiphasia setifer Swainson, Nat. Hist. Fish, II, p. 259, 1839. *Ophidonidæ.* (Based on the figure given in Russell's Fishes of Coromandel, 1803. Plate 39.)

Nemophis Lessoni Kaup, Proc. Zool. Soc., p. 168, and figure, 1858. Also Ann. Mag. Nat. Hist., p. 301, and figure, Oct., 1858. *Nemophidæ.* (Two specimens in Jardin des Plantes, 255 mm. long. Locality unknown. Kaup overlooked the ventrals, and his figure is not accurate in giving the commencement of the dorsal, and in omitting the caudal.)

Nemophis lessonii Günther, Cat. Fish., III, p. 296, 1861. *Blenniidæ.* (After Kaup.)

Xiphogadus setifer Günther, Cat. Fish, IV, p. 374, 1862. *Ophidiidæ.* (Based on Russell's figure, plate 39; and states that the specimen figured by Russell was 14 inches long, and from Vizagapatam, East Indies.)

Xiphasia trachypareia Bleeker, Nederl. Tydschr. Dierk., p. 194, 1864; and with a plate in Versl. en Mededeel. Akad. Wet. Amsterd., XVII, p. 193, 1865. *Blenniidæ.* (The habitat of this specimen is unknown. The figure probably represents an adult specimen about 18 inches in length, and agrees very well with the young specimens I have examined, except that Bleeker's figure represents the abdominal portion one-fourth longer in proportion to the head than in my specimens, and the body as not constricted back of the vent; but these differences may be all owing to age.)

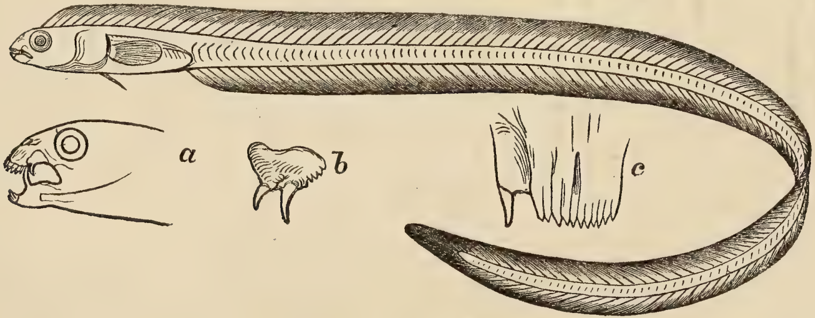
Xiphogadus (*trachypareia*), Günther, Zool. Record., I, p. 158, 1864 (1865). *Blenniidæ.*

Nemophis sp. Gill., Ann. Lyc. Nat. Hist., N. Y., VIII, p. 140, note, 1865. *Nemophidæ.* (Mention of a specimen from Madagascar.)

Xiphogadus madagascariensis Playfair, Proc. Zool. Soc., p. 11, 1868. (The specimen, which is 11½ inches long, was taken from the stomach of a fish from the Mourounda River.)

Nemophis, Günther, Zool. Record, V, p. 150, 1868 (1869). *Blenniidæ.* (The several described species of Nemophis and Xiphogadus are stated to be one, and Günther mentions that he has examined nine examples obtained in various parts of the Indian Ocean.)

Head obtuse, arched, flat between the orbits. Eyes large; the upper margin of the orbit forming the arch of the head; diameter of the eye equal to the interorbital space, and to nearly one-third the length of the head. Mouth nearly horizontal, extending to beneath the front margin of the eye. Body just back of the vent slightly constricted, not as high as the front part of the abdominal portion, or as the head, and tapering gradually to the caudal fin. The width of



Xiphasia setifer. Young, natural size.

a. Head enlarged and skin removed to show the maxillary and the canine teeth.
b. Maxillary from the left side, enlarged and showing the canine teeth, which in this instance were two in number, though normally there is but one.
c. Front view of intermaxillaries and the right maxillary, enlarged to show the line of union.

the head is less than one-half of its length, and its length is equal (in small specimens) to the distance from the base of the ventrals to the vent.[1] The length of the head is contained from thirteen and one-half to nearly sixteen times in the total length.[2] Pectorals with ten rays, slightly pointed, and a little longer than one-half the length of the head. Ventrals slightly less than one-half as long as the head. Dorsal rays of nearly equal length throughout, and not quite equal to one-half the length of the head, situated at moderate distances apart, the last ray connected by a membrane to the caudal. Anal rays of about the same length and distance apart as the dorsal, the last ray united by its membrane to the caudal slightly beyond the line of union of dorsal and caudal. Caudal with ten rays, the central being longer than the others, forming a short pointed fin.[3] Color in spirits light brown; lighter on the abdomen where the silvery peritonæum shows through the walls; numerous dark dots on the body along the base of the dorsal and anal fins, and on the head; dorsal, anal and caudal fins dark, so that when the rays are not extended they form a black border from the head between the eyes, round the caudal forward to the vent.

Indian Ocean and China Sea.

Agassiz Collection. No. 2463. China Sea, Capt. David Ranlett, 1859. (One specimen. 6.4 inches.)

Agassiz Collection. No. 2474. Habitat? Andrew Garrett (No. 31.) (One specimen. 6.6 inches.)

In order to include all the references to this family, as at present understood, I abstract the principal characters by which *Plagiotremus* is distinguished from Xiphasia from Prof. Gill's description of the genus and species he has referred to the family. As has been previously stated, the genus *Petroscirtes* (Bennechis C. and V.) among the Blenniidæ has affinities with the Nemophidæ, and may prove to be another genus of the family, but I have not specimens at hand for examination.

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[1] In the figure given by Bleeker the abdomen is one-quarter longer than the head.

[2] In a specimen 6.4 long the head is contained thirteen and one-half times in total length; in another, 6.6 long, nearly sixteen times; Bleeker gives the head as contained sixteen and one-half times in a specimen about 18 inches long, and Playfair gives seventeen times in a specimen 11.5 long. Günther also states that the nine specimens examined by him differed in the length of the snout.

[3] Bleeker gives the following ray formula, D. 121 + C. 12 + A. 110, = D. C. A. 243; P. 14; V. 2.

PLAGIOTREMUS.

Plagiotremus Gill, Ann. Lyc. Nat. Hist., N. Y., VIII, p. 138, 1865 *Nemophidæ*, subfamily *Plagiotrematinæ*. *Plagiotremus*, Günther, Zool. Record, II, p. 191, 1865 (1866). *Blenniidæ*. (Günther here states that the genus has affinities with Xiphogadus.)

Dorsal fin begins over the operculum, and is coterminal with anal, neither fins being united to the caudal. No ventral fins. Canine teeth in under jaw only.

Plagiotremus spilistius.

Plagiotremus spilistius Gill, Ann. Lyc. Nat. Hist., N. Y., VIII, p. 140, pl. 3, f. 1, 1865.

Head twice as long as high; about an eleventh of the total length. Caudal well developed, and with the outer rays about twice the length of the inner. Body uniform purplish. Pectoral fin with a dark spot at base of upper rays. Dorsal fin with several rows of blackish dots.

China Sea, Dr. Wm. Stimpson. (One specimen. 5½ inches long.)

Mr. S. H. Scudder announced that the American Academy of Arts and Sciences had recently addressed a memorial to the Legislature, urging a new and thorough scientific survey of the State. Through the rapid advance of science, the published results of the old survey, undertaken a generation ago, have become insufficient; and the interests of science and general education, as well as the material prosperity of the Commonwealth, demand a more thorough and systematic study of our natural products and resources. He suggested, therefore, that a committee of seven should be appointed with full power to support the memorial of the American Academy on the part of the Society.

The proposition was warmly supported by other members of the Society, and the President and Messrs. John Cummings, W. H. Niles, F. W. Putnam, B. Joy Jeffries, Edw. S. Morse and A. Hyatt, were chosen as a committee to prepare and present to the next Legislature a petition in aid of the Academy's memorial.

Section of Microscopy. April 8, 1874.

Mr. Bicknell in the chair. Eleven persons present.

Mr. Stodder exhibited scales of *Petrobius maritimus* and *Amathusia Horsfeldii*, to show that the so-called "beads" were the results of imperfect observation and illumination.

Mr. Bicknell exhibited and explained his achromatic condenser, made by Mr. Tolles after the design of Mr. Bicknell. Its focal distance is $\frac{4}{10}$, and its aperture 150°. Its most important variation from other condensers is in the position of the stops, the diaphragm-plate being placed close to the front lens, which gives a power of controlling the illuminating ray greatly superior to that possessed by other condenser.

Mr. Samuel Wells exhibited a heliostat, remarkable chiefly for the small expense at which it was constructed.

It was made from a marine clock, capable of running like a watch, in any position; the hands being removed, a pulley of $\frac{1}{2}$ in. diameter is slipped on to the arbor of the hour hand; on the wood work at the top of the clock is fastened bearings for a small shaft, carrying at its upper end the plane mirror intended to follow the movement of the sun. On this shaft is a pulley one inch in diameter, deriving motion from the pulley on the hour hand arbor by a cord. A support attached to the side of the clock carries a subsidiary mirror directly above the revolving mirror. The clock is hung on a board, hinged so as to be capable of elevation to an angle equal to the complement of the latitude. The face of the clock is turned to the north. The revolving mirror is adjusted to the declination of the sun so as to reflect the day to the north. The ray is received on the subsidiary mirror, which reflects it in any required direction.

The cost of the heliostat was less than twenty dollars, and its performance sufficiently accurate for microscopic purposes.

April 15, 1874.

The President in the chair. One hundred and twelve persons present.

Dr. Samuel Kneeland read a paper on the geology, geography, and scenery of the Union Pacific Railroad, illustrated by specimens of ores, fossils, and minerals found along the route from Cheyenne to the Sierra Nevada, with lantern illustrations of such of the scenery as best displayed the geological features.

After pointing out the geographical features of rivers, plains, lakes, and mountains along the route, he drew attention to the fertility of Eastern Nebraska, especially along the valley of the Platte River, well adapted for cereal grains, fruits, and vegetables. In Western Nebraska and Wyoming the alkali region begins, and is unfit for agriculture; but, when properly watered, one of the finest and largest grazing countries in the world — the sterility not depending on the alkali, but on the absence of water to carry it off; this extensive region is probably the residue of the evaporation of a large inland sea, whose waters were charged with alkaline salts from the surrounding mountains, in a basin without an outlet.

From Omaha westward, for about one hundred and twenty miles, there are the carboniferous and secondary limestones and cretaceous strata; then the tertiary marls and clays to the mountains west of Cheyenne, the mountains themselves here having a nucleus of reddish felspathic granite, probably of Laurentian age.

The Laramie or Black Hills, with Sherman at their top, formed the western shore-line of an immense fresh water lake on the eastern slope of the mountains during the middle and upper tertiary, the eastern shore of this lake extending to the vicinity of Grand Island; this lake occupied an area, now almost waterless, of more than one hundred thousand square miles. The nearly level character of these plains shows that the upheaval of this plateau was gradual and of long continuance, embracing the five hundred miles between the Missouri and the mountains, the lofty ranges bursting through at a comparatively recent period, draining off the waters with an immense denudation, here and there great thicknesses of clays, marls, sand, and sandstones being left high on their sides, and sometimes reaching to the very crest; the effects of this denudation are now seen in the pyramidal, castle-like and fantastically shaped forms, known as "buttes," of various colors, horizontally stratified, and hundreds of feet high, showing what was once the general level of the country, now so nearly washed away. The track of the road here is, therefore, for hundreds of miles over the bed of a tertiary lake.

The strata on the west correspond to those on the east of the ranges, showing that they are great anticlinal folds, whose strata slope in opposite directions, the numerous deep valleys being worn in the fracture of the central line of elevation.

The "Laramie Plains" is a mountain prairie, at an average elevation of six thousand five hundred feet, comprising an area of six thousand seven hundred and fifty square miles, and an excellent grazing region. Beyond these plains traces of coal begin to be seen. The coal at Carbon, eighty miles from Laramie, is very near the track, abundant, of excellent quality, a compact tertiary lignite. The coal extends for many miles in all directions, showing that this desert was, at a comparatively recent geological epoch, covered with luxuriant vegetation. At Green River occur the great bluffs of bituminous shales, mentioned in Hayden's Report for 1872, p. 337, which have recently been profitably used for the extraction of an excellent mineral oil.

He showed pictures of the Echo and Water cañons, near Salt Lake, including the Salt Lake, all of which region, including the Salt Lake basin, was once, according to Hayden, a vast fresh water lake; the waters were slowly evaporated, leaving the terraces to mark the changes and the former levels of the lake — briny, indeed, not from the sea, which had been shut out from this region long before, but from salt springs and concentration in this closed basin. The lake itself is very old, and part of the great water area once extending from the Wahsatch Mts. on the east to the Sierra Nevada on the west, from the mountains of Columbia on the north to those of Colorado on the south. The researches of Fremont, Stansbury, the Pacific Railroad geologists, and Hayden, all confirm the above conclusions.

ERRATA ET ADDENDA.

Page 109, line 112. For "**Myiadestes townsendi**" read "**Phainopepla nitens.**"
Page 109, line 33. For "**capalis**" read "**carpalis.**"
Page 118, line 15. For "36" read "37."
Page 241, line 5. For "black, edged" read "black-edged."
Page 243, line 30. For "*borealis*" read "*Faustina.*"

Some of the nests and eggs described in the paper of Dr. Brewer, pp. 106–111, were described by Dr. Coues in the "American Naturalist," after its presentation but before publication.

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